

Examining Urban Wildlife Conservation and Green Space Development Opportunities for Triangle Land Conservancy

by

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Executive Summary

Rapid urban development has led to the displacement of wildlife and the disturbance of natural landscapes. As a result, biodiversity conservation and human access to natural resources are threatened. The purpose of this project is to examine existing urban conservation work and literature as a means to develop urban habitat improvement guidelines for the Triangle Land Conservancy. Triangle Land Conservancy (TLC) is a non-profit land trust in Durham, N.C. that works to conserve lands fulfilling the following four benefits: safeguarding clean water, supporting local farms and food, protecting natural habitat, and connecting people with nature. TLC is interested in shifting toward urban conservation work because urbanization affects all four of these benefits, either directly or indirectly. As urban areas increase, it is vital to understand how species coexist and thrive in human-dominated areas in order to continue with conservation efforts.

This project examines a sample of 30 cities and scores their respective conservation plans, based on existing criteria from established sources, in order to determine best practices that can be used to improve urban habitats. The cities are evaluated based on their wildlife conservation and green space development guidelines. The second part of this project is a case study of how a different organization currently conducts urban conservation work. This case study explores the working tools and approaches of an urban land trust (Openlands), and evaluates the efficacy and value of an urban conservation plan. Findings from these analyses are used to form urban conservation recommendations for TLC. These recommendations come as a response to TLC's recent revised strategic plan, which incorporates several new urban conservation goals.

General results from this project reveal that existing conservation plans for cities are incomprehensive and lack substantial conservation approaches. In additions, independent non-profit organizations are not restricted by city government conservation guidelines. For these reasons, a comprehensive urban conservation plan would provide great value to organizations that are shifting toward urban conservation approaches. For TLC, this type of conservation plan includes the following key points and recommendations:

- Secure vacant lots to transform into green spaces for community use and wildlife protection.
- Implement conservation-focused community projects in urban areas in order to engage city residents in environmental educational activities that may serve the community and surrounding natural areas
- Raise public awareness of urban environmental issues in order to garner collective action and public support.

This conservation plan for TLC involves varied approaches ranging from GIS-based strategies to community outreach programs. These recommendations may be enacted separately or in conjunction with one another, but aim to serve as a guide for TLC's future urban conservation endeavors.

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I. Introduction

Towering skyscrapers, carefully designed transit systems, and large crowds of people create a familiar bustling environment—the city. Known for its convenience to modern amenities and resources, a city provides a plethora of opportunities for its residents. In cities, there is more efficient utilization of space, efficient transportation and sharing of resources, and integrated neighborhoods, which promote diversity and development of social capital (“Livable Cities”, 2007). Urban areas clearly offer many benefits that are not found in rural or more isolated areas. However, through the act of urbanization, cities also cause environmental consequences that are not fully understood or resolved. Urbanization specifically describes the increasing trend of people moving into urbanized areas, which is defined as an area with a population of 50,000 people or more, or a density of 1,000 people per square mile (U.S. Census Bureau, 2010). Worldwide, the urban population has grown from 746 million to 3.9 billion people in the past 64 years (1950-2014) (United Nations, 2014). It is estimated that approximately 2.5 million people will be added to the world’s urban population by 2050 (United Nations, 2014).

Currently in the United States, 80% of the population live in urban areas and this number is expected to drastically increase (U.S. Census Bureau, 2010). The top three most populated cities in the U.S. are New York City, Los Angeles, and Chicago, with 8.5 million, 3.8 million, and 2.7 million people respectively. Although the majority of American cities are not at this magnitude, urban areas still present city-specific problems. With urbanization comes the spread of housing developments and new infrastructure, which impinge on natural landscapes and affect wildlife in a variety of ways such as imposing new threats to biodiversity. Urban areas present unnatural advantages to some species of wildlife by removing top predator abundance and providing resources for scavenging species (Marzluff & Rodewald, 2008). Studies have revealed

urban-dwelling wildlife to adapt their diets and behaviors in order to become generalist species--species that can survive and thrive in a variety of environmental conditions and resources (Marzluff & Rodewald, 2008). However, cities also present new threats such as vehicular traffic, human contact, and disease. As urbanization continues, human-wildlife conflict and cases of wild animals inhabiting human residential areas will increase. Because of these negative outcomes, it is important to understand how wildlife species are affected by anthropogenic growth and city development as a means to effectively implement city planning efforts while minimizing damages to natural habitats.

Built environments and cityscapes not only impact wildlife, but they also impact people by detracting from opportunities for city residents to access green spaces. Cities with more green space contribute to greater well-being for city residents (Abrams, 2013). Factors of greater well-being include less mental distress, higher life satisfaction, and more recreational opportunities leading to an active lifestyle. Urban green infrastructure also increases economic growth through the augmentation of property values near parks, as well as savings in pollution abatement (Abrams, 2013). Green spaces and natural habitats in cities provide immense use and nonuse values; therefore, city managers and partnering organizations should consider the importance of protecting, restoring, or creating natural habitats in urban areas to benefit people and wildlife. A mixed approach involving the assessment of social and biological demands should be applied to environmental ecosystems in a changing world to examine how urban areas affect natural resources.

II. Project Objective

The purpose of this project is to examine existing urban conservation work and literature as a means to develop urban habitat improvement guidelines for the Triangle Land Conservancy.

Triangle Land Conservancy (TLC) is a non-profit land trust in Durham, N.C. that works to conserve lands fulfilling the following four benefits: safeguarding clean water, supporting local farms and food, protecting natural habitat, and connecting people with nature. TLC is interested in shifting toward urban conservation work because urbanization affects all four of these benefits, either directly or indirectly. By integrating traditional land stewardship tools and new projects into an urban environment, TLC can effectively address these four benefits in future urban projects. As urban areas increase, it is vital to understand how species coexist and thrive in human-dominated areas in order to continue with conservation efforts. This project examines a sample of city plans and scores their respective conservation tools in order to determine best practices that can be used to improve urban habitat health. It is hypothesized that most city plans will be low ranking and will not have an urban conservation component, which would further emphasize the need for more specialized and comprehensive urban conservation efforts.

Ideally, the results and conclusions drawn from this project would be applicable to cities nation-wide and produce a workable urban habitat improvement plan. It is hoped that city managers will consult this urban habitat plan when considering urban wildlife conservation strategies. The final product of this project is a report documenting the research and literature review process and analysis (section IX). Within this report are recommendations and guidelines for TLC to expand wildlife conservation and community development work into urban areas. These recommendations were developed as a response to TLC's recent revised strategic plan, which incorporates several new urban conservation goals. The second part of this project is a case study of how a different organization currently utilizes a comprehensive plan or guidelines to conduct urban conservation work (Appendix 5). This case study will explore the working tools and approaches of an urban land trust, and evaluate the efficacy and value of an urban

conservation plan. The case study organization is Openlands, a land trust in Chicago, and results from the case study will be used to shape recommendations for TLC.

III. Background

Effects of Urban Development on Wildlife

Since urban development in the United States is a relatively recent phenomenon that more rapidly began in the late 19th century, the surrounding natural biota has been slowly adapting to a changing environment. Based on varying wildlife responses to urbanization, species can be categorized into three functional groups: urban invaders, suburban adapters, and urban avoiders (Marzluff & Rodewald, 2008). Urban invaders, such as the common pigeon and rat, thrive in urban areas. These species are adept in colonizing urban areas because they have small ranges and respond well to the supplemental foods and lack of natural predators provided by human dwellings. As a result, urban invaders are rare in natural areas. Second, suburban adapters such as the coyote and American robin are abundant in disturbed edge habitats. These habitats provide diverse vegetation and moderately dense areas that provide enough food and space for suburban adapters to attain high density and fitness. Lastly, urban avoiders such as large carnivores and sensitive bird species specialize in interior native habitats, far from anthropogenic influence. Urban avoiders tend to occupy large ranges of undisturbed, contiguous lands or thrive in specialized, niche habitats.

Although the above categorization accurately describes the way most species respond to urbanization, there are also non-urban adapter species that temporarily utilize urban habitats to their best interests. For example, migratory birds use urban greenways as stopover habitat to replenish fat stores and avoid predation (Kohut et al., 2009). Similarly, a study found that crows, which are suburban adapters, disperse from suburban areas into urban areas as they exploit

productive breeding habitat in suburban areas and anthropogenic food sources in urban areas (Withey et al., 2005). Bats are also found to forage in and around cities, although they may roost in cave dwellings and tree cavities in edge environments. A study found big brown bats (*Eptesicus fuscus*) to be feeding in illuminated urban sites up to 5 km away from patches of vegetation, as anthropogenic structures such as streetlamps and porch lights tend to attract flying insects (Avila-Flores & Fenton, 2005). Urban areas may provide a semblance of an artificial ecosystem to non-urban species, which highlights the role of urban habitats in a larger context.

Overall, generalist species and those that can easily adapt to environmental changes tend to do well in cities. In birds, behavioral modifications, such as adjusting song patterns, help species call above city noise. Songbirds that do not have wide frequency may end up disadvantaged in noisy urban neighborhoods and unable to successfully mate (Hunter, 2007). Similarly, a European study found that common passerines change their flight initiation distance (FID) in response to vehicle speed (Legagneux & Ducatez, 2013). FID is the distance at which birds fly away from an approaching threat. The study revealed that FID increases with speed limit, which suggests that birds adjust their flight distance to reduce vehicle collision risks (Legagneux & Ducatez, 2013). Some urban-adapted species also display changes in coloring or other morphological adaptations, which may be an indication of rapid microevolution occurring in cities. Kettlewell's pioneering experiment on peppered moths revealed cases of industrial melanism, an effect of urban pollution that led to darker tree colors (Kettlewell, 1973). Consequently, peppered moths with darker, recessive traits had a better chance of survival in cities because of their ability to blend in with darker trees.

Although urban areas may prove to be advantageous to adaptive species, they pose many threats to vulnerable specialist species. Studies have shown that an increase in human population

density decreases surrounding species richness (McKinney, 2008). This is caused by the development of impervious surfaces in urban areas that contribute to habitat fragmentation and reduce the availability of food and shelter for wildlife. Urbanization also leads to the structural simplification of vegetation, through landscaping practices that remove plant diversity and encourage mowing (McKinney, 2008). As a result, the homogeneity of urban habitat and food sources allows invasive generalists to outcompete non-synanthropic species, which are species that do not live near and do not benefit from humans. General observations of urban wildlife reveal that cities provide favorable habitat to large populations of few species, whereas suburban areas have more diverse wildlife. Peak species richness is observed in intermediate levels of urbanization, such as suburban areas, likely due to increased heterogeneity of natural habitats and an increase in food resources from human influences (Grimm et al., 2008). In these peri-urban zones, natural predation and competition combined with a patchwork of specialized habitats prevent urban species from displacing suburban adapters (Shochat et al., 2010).

Despite suburban areas providing more opportunities for biodiversity, the distribution of wildlife along the urban to suburban transition zone causes many cases of human-wildlife conflict due to the prevalence of wildlife being found in close proximity to human dwellings. Physical interactions between humans and wild animals may increase zoonotic disease transmission, such as rabies. In the United States, wild animals account for approximately 92% of reported rabies cases, with raccoons contributing to 35% of these cases (Center for Disease Control, 2011). Although human rabies deaths are on the decline, rabies transmission through wildlife is still a risk that must be addressed. Similarly, Lyme disease is transmitted from wildlife to humans through deer ticks (*Ixodes scapularis*) acting as vector species. Humans can unknowingly attract ticks while hiking or working outdoors. Dogs, cats, and wildlife species can

also bring infected ticks into homeowners' yards. According to the Center for Disease Control and Prevention, approximately 300,000 cases of Lyme disease are diagnosed each year (2011). In addition to the spread of disease, another human-wildlife conflict is the disruption of natural habitats by domestic pets. A study found that domestic cats cause declines or local extinctions of native fauna in island and mainland environments (Calver et al., 2011). In the United States, it is estimated that pet and feral cats kill around 100 million birds and more than a billion small mammals on an annual basis (Calver et al., 2011). Another urban conservation problem is the lack of connectivity between natural habitats that makes it difficult for wildlife to navigate through cities without encountering vehicular traffic. The National Highway Traffic Safety Administration reports that animal-vehicle accidents cost \$1 billion annually in property damage and contribute to approximately 165 human deaths (2002). To mitigate these obstacles, urban planners and city managers should strive to make the most compact use of existing urban centers to reduce sprawl and prevent further urbanization consequences.

Effects of Urban Development on People

Urbanization greatly affects human health in the form of various types of pollution. Vehicular and factory emissions cause air pollution through the release of harmful substances such as carbon dioxide and hydrocarbons, which react with nitrogen oxide to create ground-level ozone (World Health Organization, 2014). High concentrations of ozone qualify as a greenhouse gas because ozone absorbs and traps infrared heat, thereby contributing to global climate change. Emitted toxins also increase smog in the atmosphere while reducing lung capacity and respiratory health. Additionally, sulfur dioxide emissions from factories form fine particles that penetrate lungs and cause health risks to young children and asthmatics. Overexposure to air pollution can be fatal, as evidenced by the World Health Organization's report that 7 million

deaths occurred worldwide in 2012 from air pollution-related incidents (World Health Organization, 2014).

In addition to air pollution, urbanization also causes water pollution in the form of stormwater runoff. Stormwater runoff occurs when rainwater floods through streets and non-absorbant surfaces, such as parking lots and roofs. The runoff water picks up remnant pesticides, sediments, bacteria, and petroleum by-products from impervious surfaces and carries these substances to nearby rivers and streams. These pollutants contaminate drinking water sources and other bodies of water that may be used for recreational activities. Another consequence of urbanization is noise pollution. Noise pollution can be defined as disturbing or excessive noise from vehicular and air traffic, construction, and general undesirable city sounds (“Noise Pollution”, 2014). Studies have shown that there are direct links between noise pollution and health, as prolonged exposure to noise pollution can cause hypertension, high levels of stress, hearing loss, sleep disruption, and psychological damage (“Noise Pollution”, 2014). Noise pollution is often a result of poor urban planning or a consequence of environmental discrimination, which stems from unequal distribution of environmental benefits and burdens (“Noise Pollution”, 2014).

Urbanization also causes a phenomenon known as the urban heat island effect. This describes the significant increase in temperature in metropolitan areas compared to surrounding rural areas, most likely due to human activities. The urban heat island effect occurs when the abundance of impervious surfaces, such as roads and sidewalks, reflect sunlight and heat back into the atmosphere. As a result, this reflection causes the air around urban areas to feel significantly warmer. Due to the urban heat island effect, the mean air temperature of a city with 1 million people or more can be 2-5 degrees Fahrenheit higher than its surrounding rural and

suburban areas (“Heat Island Effect”, 2014). Unlike forested areas that are covered with soil and trees, impervious areas prevent evapotranspiration from occurring, which is a natural process that cools down surface area. Trees also provide shade, low albedo (reflective surface), and carbon dioxide absorption—all factors that contribute to temperature regulation. A simple solution to reducing the urban heat island effect is to plant more trees and create non-impervious and absorbent surfaces.

Biodiversity Benefits

From a biological standpoint, urban habitat conservation would be highly beneficial because of its capability to protect local biodiversity. As previously mentioned, a practical way to reduce the urban heat island effect is to plant more trees and vegetation. Properly managed trees in an urban area help shade and cool the surrounding environment, thereby producing a healthier ecosystem (“Reducing Urban Heat Islands”, 2014). However, these trees would serve a dual purpose by also providing natural habitat for wildlife, such as small mammals and migratory birds. In an otherwise inhospitable environment, urban green spaces and patches of vegetation can offer natural habitat for wildlife and, as a result, increase the health and diversity of wildlife populations. By providing more natural habitat, city planners can prevent further habitat destruction, help reduce wildlife encroachment on human space, and minimize human-wildlife conflict. Most cases of human-wildlife conflict result from the displacement of wild habitats and natural territories by human development. Consequently, to compensate for a shortage of resources, wildlife will wander into developed areas to search for food and shelter. This can lead to property damage, predation of domestic animals, and injury to humans or wildlife, leaving a mutual distaste toward both parties.

Anthropological Benefits

While urban habitat conservation serves its core purpose as a means to protect natural resources and wildlife in urban areas, this strategy can also benefit social development and urban community growth. By expanding conservation work into urban areas, city managers and organizations can reach out to communities that would not typically have access to nature preserves or partake in recreational activities. As a public good and investment, green spaces should be distributed in an equitable manner to best serve the entire general public. Recent studies on environmental justice reveal that environmental goods are often unequally distributed among different socio-economic and demographic groups (Boone et al., 2009; Sherer, 2006). A 2009 study found that parks in Baltimore that are geared toward under-resourced communities offer less acreage of park space compared to the parks that are within high-income areas. This leads to an unequal distribution of park space so parks that are in low-income communities have higher congestion than areas that are predominantly high-income (Boone et al., 2009). This environmental injustice can be a result of faulty public planning and/or the lack of public participation by minority groups. Equal environmental actions require the ensuring of traditional non-participants and communities, such as low-income groups, women, and ethnic groups, to contribute to the decision-making process (Clarke & Agyeman, 2011). Unfortunately, those who often find themselves marginalized by society may have a harder time building social capital to rally political and community support. Consequently, the environmental signatures of social power become increasingly distinct and more difficult to democratize. Community-based environmental involvement can help emphasize the benefit of connecting people to nature and also foster other benefits.

Existing Urban Conservation Methods

Currently, urban conservation work involves an amalgamation of tools, ranging from the less intensive to more intensive techniques. This section will cover several common urban conservation practices.

Green Roofs

Green roofs are identified as rooftops that are planted with vegetation layers in an attempt to shade roof surfaces and reduce surface heat. When properly managed, green roofs can block up to 70% of sunlight from reaching the underlying roof membrane, which cools the surrounding air (“Green Roofs”, 2014). One type of green roof is the extensive roof, which is simple and lightweight, with low-maintenance plants that do not require an irrigation system (“Green Roofs”, 2014). On the other hand, intensive green roofs can have any type of vegetation, which would require more maintenance over the long-term and more structural support. Intensive green roofs also require an irrigation system and serve as a public garden as well (“Green Roofs”, 2014). The irrigation systems on green roofs may also provide enhanced stormwater management and water quality.

Green roofs provide many benefits to people, especially those residing or working in the building. Green roofs also serve as urban wildlife habitat. In a 2014 study, the National Wildlife Federation observed that insect diversity is about six times greater on green roofs than on traditional roofs. Migrating birds have also been observed to rest on green roofs and an abundance of green roofs can form a patchwork of bird habitat (Nuwer, 2014). Green roofs may be attractive to urban wildlife because they are well maintained, have a tendency to be quiet at night, and encounter less human traffic. Nesting boxes, bird feeders, and bat houses can be constructed on green roofs as a way to utilize this space to create healthy wildlife habitats. It is

important to keep in mind though that green roofs designed for wildlife habitats are more intensive and require a diverse array of vegetation, natural substrates, and different forms of shelter, such as logs and stones.

Although green roofs provide multiple benefits for people and wildlife, their high upfront costs and maintenance requirements may be a deterrent. The average cost for green roof installation is \$464,000, compared to \$335,000 for conventional roof installation (“Green Roofs”, 2014). However, it is reported that a green roof will save approximately \$200,000 in energy savings in the long run. In the United States, Chicago, Washington, D.C., and Baltimore are the cities with the most green roofs installed (ranging from 100,000 to 500,000 square feet) (“Green Roofs”, 2014). Green roofs are an effective way for cities to utilize already-developed space, save energy costs, increase green spaces in urban areas, and provide natural habitat.

Urban Parks and Gardens

Urban parks and gardens increase the aesthetic value of an area, provide recreational space for residents, and also provide habitats for urban wildlife. Urban parks can function as wildlife reserves as even relatively small areas of land can act as a haven for urban avoiders and help with colonization (Marzluff & Rodewald, 2008). A 2009 study found that wild populations of the common eastern bumblebee (*Bombus impatiens*) were significantly abundant in New York City community gardens (Matteson & Langellotto). This study suggests that bumblebees depend on community gardens as a foraging resource within cities, and that bumblebees act as an important pollinator for many common crops grown within these urban parks and gardens. Similarly, the common frog (*Rana temporaria*) in Britain has experienced population declines in rural areas but increases in urban populations (Goddard et al., 2009). This suggests that urban habitats have the potential to support high densities of wildlife if the environment is suitable.

As previously mentioned, urban parks and gardens also allow city residents, whom do not typically have access to nature preserves, to partake in outdoor recreation and environmental activities. Those who live closer to parks and green spaces will have more opportunities to engage in outdoor exercise. Community gardens are also important because these spaces are managed by community residents and help foster urban environmental stewardship. Urban gardens usually stem from vacant lots or abandoned plots of land. Vacant lot transformations contribute to city renewal through the act of beautifying formerly neglected areas and creating peaceful, safe places. In community gardens, residents come together to plant and grow their own flowers, fruits, and vegetables. These spaces integrate natural habitat conservation with community expression, by providing environmental and cultural potential. Another environmentally efficient way to utilize city space is to support the construction and preservation of greenways. Greenways are linear tracts of forested land that serve an aesthetic value and provide a means of alternative transportation and outdoor recreation (e.g. bike routes). A 2009 study revealed that migratory birds use greenways as stopover habitats to replenish fat stores and avoid predation (Kohut et al., 2009). Greenways of all sizes with varying types of trees were utilized by birds, which suggest the value of conserving any and all types of greenways. A combination of greenways and urban parks can form ecological networks within cities and address ecological connectivity issues.

Unfortunately, U.S. cities are deficient of park spaces. In Atlanta, parks only cover 3.8 percent of the city's area and existing green spaces are no larger than one-third of a square mile (Sherer, 2006). Similarly, low-income communities with bigger minority populations are typically devoid of park space. The Trust for Public Land reports that white neighborhoods (areas where Caucasians make up 75% or more of the residents) in Los Angeles provide 31.8

acres of park space for every 1,000 people, compared to African-American neighborhoods with only 1.7 acres of park space for every 1,000 people (Sherer, 2006). The inequitable distribution of urban parks further exacerbates health problems for communities that are already marginalized by society and find difficulty in accessing resources. Uneven allocation of environmental benefits among different socio-economic groups is especially prominent in metropolitan areas and emphasizes the need to minimize social disparities through urban green space development.

Wildlife corridors

A major consequence of urban development to wildlife is the loss of productive and diverse habitat. As natural lands are cleared for human use, habitat patches for wildlife become small and fragmented. Wildlife corridors are a proposed remedy for habitat fragmentation because they attempt to connect at least two significant habitats. The purpose of wildlife corridors is to facilitate dispersal of isolated individuals between different habitat patches to recolonize new areas. Connectivity between fragmented habitats is especially important when considering sink and source populations. Sink populations display low growth rates and tend to rely on source populations, which have high growth rates, in order to viably sustain the subpopulation.

In urban areas, wildlife corridors may also act as conduits to transport animals from urbanized landscapes to less developed landscapes (Bennett, 2003). Banff National Park in Canada is a prime example of integrating wildlife corridors in urban infrastructure. The park displays two overpasses constructed on the Trans-Canada Highway to maintain wildlife connectivity within the park, as well as 22 underpasses to mitigate the expansion of the highway (Clevenger, 2007). Long-term monitoring of the Trans-Canada Highway through Banff National

Park from 1996 to 2007 revealed that 10 species of large animals used the 24 crossings more than 84,000 times. Traffic-related mortality of all large mammals on the Trans-Canada Highway had also decreased by more than 80 percent (Clevenger, 2007). In addition to transporting wildlife from one habitat to another, wildlife corridors may also be designed to provide habitat for plants and animals, and act as a barrier to human disturbance (Bennett, 2003).

The creation and innovation of urban conservation practices is, in theory, promising for future urban habitat protection. However, in order for urban conservation to be successful, these practices must be implemented in an efficient and timely manner, which often requires significant funding and public interest. In addition, the aforementioned tools should be implemented in conjunction with each other for maximum effect. In urban environments, competing interests are constantly at play along with the involvement of multiple stakeholders, which is why comprehensive urban conservation plans are important. An all-inclusive, thought out conservation plan could address all components of preserving urban environments and aim for indelible sustainability. This type of extensive plan would consider the needs and roles of all stakeholders, and provide action steps for long-term cooperation and implementation success.

IV. A Land Trust's Role in Urban Conservation

A land trust is a private non-profit organization that preserves land through various strategies. Traditionally, these lands offer natural heritage or historical value. Conservation land trusts often preserve lands that contain sensitive species, habitats, or communities. These areas may also provide natural resource value such as clean water or productive agricultural lands. Typically, land trusts can buy the property of interest, accept donations of the land, or purchase a conservation easement to ensure long-term conservation practices. Land trusts have traditionally focused on protection of wilderness areas and undisturbed habitats. However, with the rapid

development of cities, urban land trusts have the potential to provide a much-needed service. For example, the Trust for Public Land (TPL) recently acquired and received permit approval from the City of Boston to create the first urban farm in a formerly city-owned parcel (“Boston’s First Right-To-Farm Site Announced”, 2014). The farm will be used by neighborhood farmers who will help provide fresh and local produce to Boston communities. In addition to creating urban farms, TPL has also prevented community gardens in New York City from being auctioned off, by purchasing and distributing several of these properties to the Brooklyn-Queens Land Trust (BQLT) and other urban land trusts. Similar to TPL, BQLT serves to protect community green spaces specifically in New York City and create citizen-managed gardens (“Our Mission”, n.d.). Urban land trusts have the capability to help local green spaces remain undeveloped and permanently provide community benefits. In addition, these protected areas serve as urban wildlife habitat. TLC has the resources and knowledge of land conservation to implement similar urban land practices, with the multipurpose goal of conserving biodiversity, fostering community development, promoting new local food sources, and encouraging long-term environmental stewardship.

As urbanization increases, the need for land trust work within urban areas becomes more urgent. To implement conservation work in urban areas, it can be assumed that land trusts will need to apply different tools and techniques. For example, the majority of TLC’s conservation properties are large contiguous tracts of natural land in forested areas of the Triangle Region. Of TLC’s seven public nature preserves, the smallest preserve, Swift Creek Bluffs Nature Preserve, is 23 acres. Whereas, urban areas present a different type of spatial construction which generally consists of continuous impervious surfaces with residential and commercial buildings, and sparsely scattered green spaces throughout. Therefore, integrating land trust work into urban

areas will require different strategies and management practices. By shifting toward urban land stewardship, TLC can play a major role in community development, engage new groups of people, and invoke in the Triangle area a sense of pride for local gardens, parks, and green spaces. Additionally, public reception of community parks and gardens tends to be positive. In a 2001 study conducted by the National Association of Realtors, half of the survey respondents were “willing to pay 10% more for a house near a park or protected open space” (Sherer, 2006). 57% of respondents also said that their neighborhood preference differs greatly between communities close to open space and those that are not (Sherer, 2006). TLC can implement urban land conservation in the Triangle Region as a way to address environmental inequity and positive community development.

V. Methods

Collecting City Data

In order to provide recommendations for TLC, I needed to determine what urban conservation tools, specifically for wildlife conservation and green space development, are currently implemented by major cities in the United States. To achieve this, I selected a sample size of 30 cities ($n=30$) in the Northeast, Mid-Atlantic, and Southeast regions (Table 1). I decided to only look at east coast cities as a way to control for any habitat and climatic variation. According to the U.S. Census Bureau, a city is defined as an area with more than 50,000 people, or a density of at least 1,000 people per square mile (U.S. Census Bureau, 2010). All 30 cities are representative of this definition (Figure 1). To begin, I researched each city’s comprehensive city plan to determine whether or not an urban habitat conservation component existed. These comprehensive city plans are written and produced by the city government and reflect specific guidelines and goals, categorized by municipal sector, that the city strives to achieve by a future

date (e.g. City of Harrisburg Comprehensive Plan 2010-2014). I also searched for urban conservation plans that were either created specifically for the city, or directly address urban wildlife and urban parks through a state plan. These plans are typically written by the city's Department of Parks and Recreation or the state's Fish and Wildlife Commission. To supplement these documents, I widened my search to non-governmental organizations that may have implemented urban conservation work in those cities. Altogether, I searched for city-level, county-level, and state-level government conservation plans, in addition to NGO plans. This amounted to a total of 59 reports.

Analysis of City Data

The goal of looking at these city plans is to determine what urban conservation work cities are doing, and evaluate which urban conservation tools are considered to be “most suitable” based on ranking systems designed by established peer-review sources and federal agencies. For the purposes of this project, “suitable” urban conservation tools are considered to be those that are preferred or weighted more by the aforementioned peer-review sources and agencies. To analyze the wildlife conservation component of these city plans, I scored the plans based on the U.S. Fish and Wildlife Service's (USFWS) Cooperative Endangered Species Fund Grant Program, as well as their Southeast Fisheries Habitat Project Ranking Criteria. I decided to use the USFWS's funding prioritization as a ranking system because the USFWS is a credible federal agency that leads high-level conservation projects throughout the country. Since the USFWS receives many grant applications, they must prioritize which applicants have the most suitable project proposals to satisfy habitat needs and species protection needs. According to Don Morgan of the USFWS Branch of Recovery and State Grants, the criteria are weighted as is (D. Morgan, personal communication, March 4, 2015). This means that the maximum score for each

sub-category reflects the weight of importance. The sub-categories and weighted percentages are as follows (Table 2):

1. Species Benefits (38.01%)
2. Ecosystem Benefits (9.35%)
3. Management (23.39%)
4. Public outreach (17.54%)
5. Partnerships and Stakeholders (11.69%)

Some of the questions used to evaluate a plan's conservation benefits include the following:

- “What is the chance of long-term success of the plan (high, medium, medium-low, low, none)?”
- “Does the plan support current habitat conservation goals of State biodiversity conservation plans?”
- “Does the plan contribute to conservation of federally or state listed species?”

The full evaluation and points associated with each question can be seen in Appendix 1.

For the urban green space development component, I compiled a ranking system using *Criteria and Indicators for Strategic Urban Forest Planning and Management* by W.A. Kenney et al., as well as the Oregon Statewide Comprehensive Outdoor Recreation Plan by T. Gallagher for the Oregon Parks and Recreation Department (Gallagher, 20012; Kenney et a., 2011) (Appendix 2). Kenney et al.'s guidelines were designed as an evaluation tool for urban forest management success and strategic management planning. These guidelines assess urban forests as a whole, and take into consideration factors such as vegetation resources, community framework, and management approaches. According to Kenney, the scoring is weighted equally

among categories and questions (A. Kenney, personal communication, September 9, 2014). The following are examples of the questions posed in this evaluation:

- “Is there even age distribution of trees in the community?”
- “Are there management plans for publicly owned natural areas?”
- “Is there a complete inventory of all the trees in order to direct management?”

The Oregon Statewide Comprehensive Outdoor Recreation Plan creates a vision for sustainable parks in Oregon and provides a “self-assessment scorecard” for evaluating if a park is implementing best sustainable practices. The scorecard is divided into 6 categories:

Administration & Finance, Fleet Maintenance, Planning & Open Space Preservation, Parks & Natural Resources Management, and Programming. For the purposes of this project, I chose to only use the scoring associated with Planning & Open Space Preservation, Parks & Natural Resources Management, and Programming because these criteria are most relevant to TLC’s interests in green space development. For example, some of the questions used in this evaluation system include the following:

- “Does your project partner with local groups to provide specific programming?”
- “Does your project increase public awareness of the benefits of natural/preserved areas with interpretive signs, educational brochures/posters, and programs?”
- “Does your project ensure that park and recreation uses adjacent to natural areas are compatible?”

With a scoring system in place, I reviewed each report for all 30 cities. Each report was given two scores, one score for the wildlife conservation component, and one score for the green space development component. Reports for the same city were averaged together, so each city had one final score for wildlife conservation and one final score for green space development. These

scores were then adjusted to reflect the weight of importance and establish a rank. I also compared the cities with one another to look for emerging trends, such as which cities performed exceptionally better or worse and what ranking criteria gave these cities the most or least number of points.

Developing a Case Study

The case study focuses on the organization Openlands, a land trust that works in rural and urban areas in and around Chicago, as requested by TLC. For this case study, I conducted a semi-structured interview with Andrew Szwak, Planning & Policy Analyst at Openlands. The interviewee was apprised of the project in advance and signed consent and confidentiality forms (see Appendix 4). Most of the interview questions were open-ended to allow for a flexible process, but several were straightforward yes/no questions. The interview was conducted via email correspondence and the set of questions were limited to 15. The questions addressed the organization's operations (i.e. land management strategies and habitat protection protocol, successes and failures, etc.) and did not pertain to personal information. Interview results were compiled into a case study report on Openlands' procedures and approaches to urban conservation (Appendix 5).

Creating an urban habitat improvement plan

Taking the results from the city plan analysis and case study, I created an urban habitat improvement plan for TLC in the form of several recommendations. These recommendations are based on the city plans that performed the best and the conservation tools that were designated more points. The purpose of creating a plan that follows these guidelines is to develop a strategy as comprehensive and ideal as possible. As previously mentioned, a thought-out conservation plan could address all components of preserving urban environments, aim for long-term

sustainability, and consider the needs and roles of all stakeholders. It was also important to incorporate traditional land trust work and TLC's goals into the recommendations in order to make the habitat improvement plan specific to TLC.

VI. City Plan Analysis Results

Results from the data analysis reveal that the city plans on average scored low (47% for the wildlife component and 37% for the green space component). The wildlife component reflects a wide range of scores (minimum: 23.39% for Richmond and maximum: 91.2% for Arlington) (see Figure 2). The highest scoring city for the green space component is Birmingham (52.9%), and the lowest scoring city is Jacksonville (24.1%) (see Figure 3). Although cities ranked relatively low on average, there were certain cities that ranked significantly better than other cities (see Appendix 3). The top 3 cities with the highest scoring city plans for wildlife conservation are Arlington, Baltimore, and Tampa. The top 3 cities with the highest scoring city plans for green space development are Birmingham, Buffalo, and Newark.

For the wildlife conservation scoring component, the sub-category that was designated the most number of points and weighted the most was Species Benefits. This category asked questions such as, "Does the plan contribute to conservation of federally or state listed; or recreationally and economically important (includes unlisted -- candidate, proposed, State-listed, and others) species?". For the green space component, the questions were assigned a 1-4 point value and were equally weighted, as previously mentioned. Since both components of this analysis are derived from different sources, the wildlife and green space scores for each city cannot be combined to determine which city has the most suitable plan overall. Therefore, this project evaluates each city twice, in two separate categories.

At the request of TLC, I also examined city plans for the inclusion of a public participation process. From this analysis, I found that the majority of these city plans do not include a public participation process for implementing new initiatives. Only 4 cities (Nashville, Memphis, Birmingham, and Baltimore) out of the total 30 specifically included language on public participation. For example, Birmingham's Comprehensive Plan states, "Public opinion surveys of residents should be undertaken at the time of updating the parks and recreation plan...Survey information should be collected to more accurately reflect community needs and desires for such investments" ("Adopted Comprehensive Plan", 2013). I also recorded the presence or absence of a water quality management component in each city plan. More than half of the cities (18 out of 30) have a clean water management plan included in their comprehensive city plans. Comparatively, all cities have a green space and parks development section to a certain degree, but only 8 cities have a definitive wildlife conservation element.

VII. City Plan Analysis Discussion

The results from the city plan evaluation reveal that there is a need for comprehensive urban conservation plans. Few plans ranked well on both criteria and most plans did not have a specified wildlife conservation plan. Although wildlife conservation is inherently included in the development of green spaces and parks, it should be specifically addressed in order to identify ways in which urban development can maintain biological diversity. Different wildlife species require different habitat needs so urban landscapes should be informed by conservation science and designed in an ecologically sensitive manner (Marzluff & Rodewald 2008). A comprehensive conservation plan that considers anthropogenic and wildlife needs would be beneficial for addressing all components of conserving natural habitats in urban areas.

Similarly, most plans did not have a public participatory element as well. It is likely that a public process was implemented prior to the making of these city plans. However, public participation as an ongoing process would be beneficial to the overall success of a management plan because productive communities tend to require the effort and dedication of all members. For instance, positive public support of new urban projects can help gain traction for other and future conservation work. It is anticipated that environmental decision-making and environmental regulation become more challenging when many players are involved because issues become more divisive. The problem then becomes whether city managers can mitigate alienation among differing stakeholders, eliminate feelings of distrust for each other and for the local government, and unify a community. Comprehensive city plans that incorporate the four core values of participatory decision-making (full participation, mutual understanding, inclusive solutions, and shared responsibility) have the potential to contribute toward effective and meaningful public involvement (Kaner et al. 2014).

Many of the city plans lack information on funding so they did not score well on questions such as “Is there municipal-wide funding for a citywide management plan” and “Has your project recently applied for grants that improve water quality”. It is possible that city governments cannot publish funding information in public documents for confidentiality reasons. However, including this information would help elucidate where city managers need to allocate resources and highlight the need for more conservation actions. Another area of need is the application of general versus actionable recommendations. Actionable recommendations are those that provide specific tasks that one can implement in order to achieve a specific goal; whereas general recommendations lean toward open-ended concepts that do not provide clear direction (Heller & Zavaleta 2009). In order for management plans to be effective, they must

comprise of a mix of actionable recommendations and general recommendations. However, the caveat to actionable recommendations is that highly specific recommendations may only be useful in target situations, and highly generalized recommendations may fail to inspire application (Halpin, 1997). Therefore, recommendations for a comprehensive conservation plan may need to include actionable and general recommendations, as well as a category of recommendations that fall between these two extremes.

Potential Challenges

In order for urban habitat management to be productive and successful, implementers must address the barriers and challenges that arise when planning for conservation. Aside from the lack of clarity with regards to funding and the inclusion of general versus actionable recommendations, barriers also include issues of zoning ordinances and development compliance. The sampled city plans do not address the process for preserving land or building green infrastructure within developed areas. These processes may be arduous and act as a deterrent to environmental organizations that want to work in urban areas. Therefore, comprehensive urban plans should include information on the project approval process and transparency in this process. Creating natural habitat preserves in cities also poses the problem of misunderstanding what land is owned by the city and what land is owned by the organization. If this is not explicitly stated, then controversy over who holds responsibility for what may arise. However, if these regulatory processes are simplified for green developers or community workers, interested parties may be more inclined to shift toward urban conservation work. Having a single department or staff member focus on green development compliance may also help simplify and expedite the process. This information should be included in comprehensive city plans for clarification.

Another potential barrier to urban habitat conservation is the hesitation from communities to provide external stakeholders access to the community. The success of a community revolves around its strengthening and growth of social capital, which is the idea that social bonds and values are important resources for individuals and groups (Pretty & Smith, 2004). Social capital is difficult to construct through external measures, as personal relationships often stem from internal exchanges and shared norms (Pretty & Smith, 2004). For this reason, many community-based environmental organizations do not work in a community unless they have been invited to do so. Without developing relations of trust and hospitality, it will be difficult for an organization to collaborate with new communities when creating citizen projects such as local urban gardens. This is why community outreach and educational awareness are important tools when building relationships with new communities in order to integrate the organization into an urban network. It is hoped that a comprehensive plan for urban conservation can address these challenges, and more, upfront and offer solutions and alternatives.

Based on this analysis, the ideal urban conservation plan would incorporate elements of wildlife conservation, green space and park development, clean water management, and public participation. The ideal urban conservation plan will follow recommendations from the top scoring cities for each respective component, and also address potential barriers and challenges in urban habitat conservation. Additionally, this plan would focus on the topics that had more weight in the scoring system, as mentioned above. Due to their weight, these components are highly valued when it comes to evaluating the conservation potential of a proposed plan or project. Results from the city plan analysis and conclusions pulled from the case study will be used to create an action plan for TLC (see section IX), in the following section.

VII. Case Study Summary

From this case study, I found that Openlands does not adhere to specific state, county, or city guidelines. Openlands has its own set of preemptive and general criteria to follow when taking on new projects. This ensures that Openlands continues to do work that adheres to the organization's mission, capabilities, and future directions. Although Openlands does not follow a set plan currently, they would find a comprehensive urban conservation plan to be helpful for new projects. Mr. Szwak of Openlands states that an inventory of resources, information on existing land use regulations, relevant conservation policies, and a list of local governments, utilities, and organizations in conservation, would be particularly useful when presented in a comprehensive plan. This type of pertinent information within an urban conservation plan would allow land managers to refer to this document as a reference guide. This case study also reveals that there are significant differences between conservation approaches in developed versus undeveloped areas. Specifically, land acquisition in cities may prove to be a challenge. Openlands rarely acquire vacant lots in cities because it involves lengthy processes of environmental site assessments, title searches, appraisals, and approvals (A. Szwak, personal communication, January 5, 2015). A comprehensive urban conservation plan may be useful for land trusts to explore new tools beyond land acquisition for urban land conservation. The full case study is attached in Appendix 5.

VIII. Action Plan for TLC Summary

This next section summarizes the Urban Habitat Improvement Plan (UHIP) for TLC, which was created for TLC to follow when implementing urban conservation initiatives. The full action plan can be viewed in the next section (IX). Recommendations in the UHIP aim to form a comprehensive urban conservation plan that incorporates comparisons of nationwide urban

wildlife management plans as well as an extensive literature review of current urban conservation tools. Suggested conservation strategies are based on the high scoring city plans (specifically, the Arlington Natural Heritage Resource Inventory Technical Report, Newark Master Plan, Green Plan Philadelphia, and Comprehensive Plan for the City of Raleigh), highly weighted criteria from the city plan analysis, TLC's specific interests and areas of focus, and the case study on Openlands. The UHIP has a general focus on the City of Durham as the project area because Durham is within TLC's work region and is a fast-growing city with a population expected to increase 64% by 2030 (U.S. Census Bureau, 2010).

There are three overarching areas for TLC to focus: securing vacant lots, creating community projects, and spreading public awareness on urban habitat conservation. The first conservation strategy recommends identifying and acquiring vacant lots and urban habitats of importance. The objective of this strategy is to transform vacant urban lands into green spaces for community use and wildlife protection. The second recommendation is to implement conservation-focused community projects in urban areas. These projects would engage city residents in environmental educational activities that serve the community and natural habitat. The third strategy is raising public awareness of urban environmental issues in order to garner collective action and public support.

The UHIP provides guidelines for TLC that involve varied approaches ranging from GIS-based strategies to community outreach programs. These recommendations may be enacted separately or in conjunction with one another, but aim to serve as a guide for TLC to use for urban conservation endeavors. For future directions and considerations, an included appendix of land use regulations and guidelines for the city in question may be beneficial, as suggested by Mr. Szwak of Openlands, as well as a listing of all ongoing and complementary efforts by local

governments, utilities, organizations and other partners that may utilize conservation (A. Szwak, personal communication, January 5, 2015). This type of reference would inform the reader of current ongoing work, relevant land use policies, and also act as a contact sheet.

IX. Urban Habitat Improvement Plan for TLC

An Urban Habitat Improvement Plan for Triangle Land Conservancy

Objective

This action plan was created for Triangle Land Conservancy (TLC) and attempts to provide guidelines for initiating urban habitat conservation work in the Triangle region. Recommendations in this plan incorporate comparisons of nationwide urban wildlife management plans, an understanding of TLC's vision and goals, information drawn from a case study on Openlands, and an extensive literature review of current urban conservation tools and approaches. It is hoped that city managers will develop and consult urban habitat plans of similar caliber when considering urban wildlife conservation strategies, based on available models and data that incorporate best practices. As urbanization continues to increase and the amount of pristine lands shrink, biodiversity conservation becomes a difficult task that will require novel solutions. Ideally, an urban habitat conservation plan would help present multiple ways to address the effects of urbanization on the environment.

Project Area

North Carolina is a diverse state containing three distinct regions: the Coastal Plain, the Piedmont, and the Mountains. The Coastal Plain describes a flat region that covers two-fifths of the state. The Piedmont is characterized by hills ranging from 150-1,000 feet in elevation and covers another two-fifths of North Carolina (NCWRC, 2005). The Mountain region covers one-

fifth of the state and contains multiple mountain ranges within the Southern Appalachians (NCWRC, 2005). More than 40 federally-listed animal species and more than 60 state endangered or threatened species occur in the state (NCWRC, 2005). In addition, there are 115 state Species of Special Concern (SSC). Located in the Piedmont region, Durham County and adjacent counties contain 23 special status species, including federally endangered or threatened species.

North Carolina, like much of the rest of the country, is rapidly urbanizing. The area of urbanized land in the Triangle Region has increased by 900% from 1950 to the early 2000's (U.S. Census Bureau, 2010) and this number is most likely expected to increase. Similarly, the population from Charlotte, N.C. to South Carolina grew 64% in the past decade (U.S. Census Bureau, 2012). Durham is no exception – Durham currently has approximately 228,330 residents and the population is expected to increase 64% by 2030 (U.S. Census Bureau, 2010). Given this trend, the City has been addressing urban planning and quality of life issues. With comprehensive work on trail planning, stormwater management and the recent approval of a new open space plan in the downtown area, the City of Durham is successfully integrating green design into its future development. However, with the help of non-profit organizations, such as land trusts and wildlife groups, the City of Durham can collaboratively and even more effectively tackle the environmental and anthropological consequences of urbanization and incorporate more green spaces.

Sensitive Species of North Carolina

As previously mentioned, there are more than 40 federally listed animal species and 60 state endangered or threatened species in the state (NCWRC, 2005). In addition, there are 115 N.C. Species of Special Concern (SSC). Durham County and adjacent counties, specifically,

contain 23 special status species, including federally endangered or threatened species. These special status species are listed in Table 3. It is hoped that this inventory of sensitive species can serve as a post-urbanization record of wildlife distribution in the Triangle Region. Urban areas in Durham also serve as important habitats for a wide range of species. The Ellerbe Creek Watershed Association (ECWA) has an urban preserve (Beaver Marsh Nature Preserve) that provides habitat for over 75 species of migratory and resident birds. In addition, 10 species of dragonflies, 5 species of frogs, and several beavers inhabit this urban preserve. The vast array of biodiversity found in Beaver Marsh Nature Preserve demonstrates the conservation potential in urban areas. Additional species that may be found in developed areas in the Triangle region include, but are not limited to, the following:

- Great Blue Heron (*Ardea herodias*)
- Great Horned Owl (*Bubo virginianus*)
- Barred Owl (*Strix varia*)
- Red-shouldered Hawk (*Buteo lineatus*)
- Red-tailed Hawk (*Buteo jamaicensis*)
- Striped Skunk (*Mephitis mephitis*)
- Raccoon (*Procyon lotor*)
- Whitetail Deer (*Odocoileus virginianus*)
- Eastern Cottontail (*Sylvilagus floridanus*)
- Eastern gray squirrel (*Sciurus carolinensis*)
- Black Rat Snake (*Pantherophis obsoletus*)
- Garter Snake (*Thamnophis elegans terrestris*)
- Eastern Box Turtle (*Terrapene carolina carolina*)
- Fence Lizard (*Sceloporus undulatus*)
- Spring Peeper (*Pseudacris crucifer*)

How to Use this Plan

The guidelines in this action plan combine conventional land trust tools, wildlife management approaches, and community-based environmental management tools as a means to provide implementable plans. This plan specifically focuses on urban wildlife conservation and

green space development projects. There are three main conservation strategies: Vacant Lots, Community Projects, and Public Awareness. Within the three conservation strategies are specific tactics for implementing the strategies. Actionable approaches are not limited to the conservation tactics listed. Conservation tactics are provided as stepping-stones for possible projects to undertake. Recommendations may be enacted separately or in conjunction with one another. This plan serves as a guide for TLC to use for urban habitat conservation initiatives.

Conservation Strategies

Conservation Strategy #1: Vacant Lots

Goals:

- Acquire vacant urban plots of land in order to maintain and build community green space
- Help undeveloped lands remain in community hands forever
- Make the most compact use of city space

Purpose:

These lands can be green spaces that are at risk of development, vacant plots located in areas with lack of green space, or vacant plots or green spaces that have special biological importance (e.g. within migratory bird range). The goal is to turn these lots into green spaces for community use. By doing so, TLC can help ensure park and garden permanence and long term urban environmental stewardship. Vacant lot transformations contribute to city renewal through the act of beautifying formerly neglected areas and creating peaceful, safe places. These lots also provide environmental and cultural potential. As a public utility, these spaces can also function as wildlife protection areas, since even relatively small reserves can provide haven and help with colonization (Marzluff & Rodewald, 2008). However, prior to turning vacant lots into green spaces the first step is to identify and acquire these lands.

Conservation Tactic 1-A: Identifying and Acquiring Vacant Lots

Objective

Vacant lots in urban areas present great opportunities for green space development. Empty parcels that are unmanaged can have negative impacts on the surrounding neighborhood. Typically, vacant lots are more prominent in under-resourced neighborhoods; therefore, turning vacant lots into vibrant and useful spaces can effectively improve the quality of urban communities. Vacant lots have the potential to be redeveloped into multi-purpose green spaces, so it is important to identify available parcels in the project area. In addition, vacant lots pose several environmental problems, such as improper drainage, poor vegetation, and illegal trash and waste dumping, which leads to polluted rainwater runoff.

Actions

The first step is to identify priority needs, as in, areas with high population densities and areas lacking green space. This can be achieved by obtaining National Land Cover Database (NLCD) layers, census data, and United States Geologic Survey (USGS) data on vegetated and impervious land cover. This data can be entered into ArcGIS, a geographic information systems (GIS) mapping tool, for a visual assessment of priority areas. For TLC and for the City of Durham specifically, a secondary approach can be taken, which is the Environmental Protection Agency's EnviroAtlas. The EnviroAtlas is a web-based tool that provides information on ecosystem services and environmental issues through an interactive map, geospatial data, GIS toolboxes, and educational materials. See the following link for more information:

<http://enviroatlas.epa.gov/enviroatlas/InteractiveMapEntrance/InteractiveMap/index.html> .

The EnviroAtlas provides broad scale data for all states, and fine scale data for selected communities, of which Durham is included ("Interactive Map", 2014). This selected community

component is based on 1-meter resolution landcover data. In addition to demographic population data and vegetation cover, the EnviroAtlas for Durham also includes map layers for boundaries (i.e. bodies of water, communities, and ecoregions), recreational services (i.e. proximity to green space and walking distances to parks, green space per capita, K-12 schools with less than 25% green space in view, etc.), and biological data (i.e. species richness, pollinator habitats, potentially restorable wetlands, etc.). Figure 4 shows a map of the population density and percent green space in Durham, generated by the EnviroAtlas. Since the EnviroAtlas has detailed information it may be a valuable resource for TLC in determining priority areas for the City of Durham. TLC can use this tool and effectively identify areas in need of green space development and locate vacant lots in the area.

Using this information, TLC can submit formal proposals to the City of Durham, or other cities, to acquire vacant parcels in high-needs areas. TLC can either purchase the plot or place a conservation easement. Or, TLC can request donations of vacant lots from neighborhood associations or private landowners. TLC can personally manage the land or share stewardship responsibilities with communities and city residents.

Conservation Tactic 1-B: Identifying and Protecting Urban Habitats of Importance

Objective

As previously mentioned, there are 115 N.C. Species of Special Concern and 40 federally listed species. 23 of these species fall in the Triangle Region and are heavily impacted by urbanization. In addition to these sensitive species, there are also many other wildlife species living in and around developed areas that are affected by rapid urbanization. A potential solution to protecting these species is to protect their habitat or provide alternate habitat. For example, small patches of undisturbed green space can serve as stopover habitat for migratory birds or a

refuge for other species. Wildlife are an important component of the earth's ecosystems, so the loss of species due to urbanization would be catastrophic.

Actions

It is important to first identify vacant parcels that are potentially suitable for wildlife inhabitation. The Green Plan Philadelphia suggests that these parcels should be contiguous to parks, wetlands, meadows, forests, and streams (Roberts & Todd, 2010). In metropolitan areas, waterways may offer great potential for sensitive species habitat. Openlands emphasizes riparian and lakefront protection and focus on riparian restoration (A. Szwak, personal communication, January 5, 2015). One of their projects is the Lakeshore Preserve, which is 77 acres of protected ravine and bluff ecosystem along Lake Michigan (A. Szwak, personal communication, January 5, 2015). Information on habitats of importance can be acquired through landcover data and used in ArcGIS. It is also recommended to use the resources available through the NC Wildlife Resources Commission and NC Natural Heritage Program to determine how to best address habitat protection. For the City of Durham, TLC can also use the EnviroAtlas, as it contains data on species richness, potential habitat stressors, and vegetation cover. Figure 5 shows a map of percent tree cover and water bodies, generated by EnviroAtlas. Similar to Conservation Tactic 1-A, once a suitable vacant lot has been identified, TLC can submit formal proposals to the City of Durham, or other cities, to acquire vacant parcels in high-needs areas. TLC can either purchase the plot or place a conservation easement. Or, TLC can request donations of vacant lots from neighborhood associations or private landowners. TLC can personally manage the land or share stewardship responsibilities with communities and city residents.

Addressing potential barriers

The main potential barrier to acquiring vacant lots is the cooperation of multiple stakeholders and approval by the city. Use of vacant lots is typically determined on a case-by-case basis and as needs arise. Many vacant lots in urban areas are developed for residential, commercial, or industrial use, rather than open space. Additionally, city parcels are typically more expensive and funding sources for urban land acquisition may be limited. This is because there are fewer benefits to biodiversity and habitat protection in urban areas compared to undeveloped lands (A. Szwak, personal communication, January 5, 2015). For these reasons, Openlands does not focus on land acquisition and instead acts as a consultant to provide technical assistance to local entities that specialize in acquiring city property (A. Szwak, personal communication, January 5, 2015). However, there are opportunities for addressing these challenges. It is recommended that TLC focus on high priority areas, as detailed in Conservation Tactics 1-A and 1-B. It may be helpful to conduct a comprehensive analysis of public and private parcels to identify vacant lots that can be re-developed for environmental and recreational usage. TLC may also look toward alternative funding sources dedicated to urban projects. Mr. Szwak stated that their funding typically comes from local community groups, local city governments, and other non-profit organizations focused on urban remediation (A. Szwak, personal communication, January 5, 2015). The following is a list of potential funding sources for TLC's urban projects:

Keep Durham Beautiful
<http://keepdurhambeautiful.org/kdb-grant-program/>

Triangle Community Foundation Funding for Nonprofits
http://www.trianglecf.org/grants_support/funding_for_nonprofits/

Durham County's Non-Profit Agency Funding Program
<http://dconc.gov/government/departments-ae/budget-management-services/non-profit-agency-funding-program>

Captain Planet Foundation
<http://captainplanetfoundation.org/apply-for-grants/>

Conservation Strategy #2: Community Projects

Goals:

- Present citizen science projects as innovative solutions to urban conservation issues
- Engage the city in multi-purpose ventures that serve the environment and the community
- Promote environmental literacy through educational programs and projects

Purpose:

Urban green spaces provide an abundance of environmental opportunities that have the potential to bring in creative ways to address urban ecological issues. Societal involvement and support are also important factors that contribute to a healthy and prosperous community. To work toward biodiversity conservation in cities, TLC can implement several community projects that would inform the public on environmental issues and their roles as citizens. These multi-purpose community projects can innovatively address TLC's benefits of supporting local farms and foods, connecting people with nature, and preserving natural habitats. This conservation strategy requires the involvement of local communities in an effort to change their own urban landscape. Public input should be received and considered, including information on the needs and desires of the community and roles of each member. This type of participatory urban planning, in conjunction with bottom-up reinforcement, can be used to generate local empowerment to help fully mobilize a community into action. As a result, outside assistance can be more effectively provided to communities that are actively developing their own inner-community relationships (Kretzmann & McKnight 1996).

Conservation Tactic 2-A: Urban Gardens

Objective

Urban gardens are hands-on projects that allow participation from all individuals. These projects can inspire locals to feel a sense of pride in their community through the beautification

of formerly neglected areas. Urban gardens cultivated for agriculture can also help address issues of food deserts and sustainable agriculture through urban fruit and vegetable gardening. With TLC's guidance or partnerships with other organizations, city residents can participate in an activity they would normally be removed from and help create a network of productive community-managed green spaces.

Actions

From Conservation Strategy #1, TLC should identify green spaces or communities in need of urban gardens. Projects can be implemented on TLC's property or on other community spaces as a partnership. The benefit to building an urban garden on TLC's land is that TLC will have control over the long-term stewardship of this parcel and help ensure its permanence. Land trusts are essential for protecting land from future development, and this mission transpires in urban areas as well.

One way in which TLC can promote the use of urban lands for community gardening is through an Adopt-a-Lot Program, which is recommended in the Newark Master Plan. The Adopt-a-Lot Program in Newark allows city residents to "adopt" a city-owned vacant lot for gardening. Through this program, the city partners with a local non-profit organization to provide technical assistance with the gardening and property maintenance ("Newark Master Plan Volume I", 2012). To create a similar program, TLC can acquire multiple vacant parcels in urban areas and allow residents to adopt these parcels for community gardening. TLC can set varying lease lengths, but it is suggested that leases last longer than one year to maximize growing and production potential.

Currently, TLC has community garden projects implemented on larger parcels of land. For example, TLC's work with Transplanting Traditions, a non-profit organization that provides

agricultural land and tools for Burmese refugee farmers, follows a model not unlike one that would be implemented for urban gardens. The Transplanting Traditions farm is located on a part of TLC's Irvin Nature Preserve and exhibits the type of partnership that TLC can form with other types of communities. TLC can also look to other local organizations for partnerships or ideas on urban gardens. Homegrown City Farms is an urban farm in Durham that grows produce on a ½ acre plot of land. This farm also offers Community Supported Agriculture (CSA) as a way to provide people with local fresh fruits and vegetables. By farming on a small vacant plot of urban land, Homegrown City Farms is efficiently utilizing space that is already developed, instead of further expending natural resources. Another local organization with urban conservation projects is Ellerbe Creek Watershed Association (ECWA). ECWA owns several nature preserves in Durham, and three of these preserves (17-Acre Woods Preserve, Beaver Marsh Preserve, and Pearl Mill Preserve) are located in urban areas. These preserves range from 3 to 32 acres, which exemplifies that any type of open space within an urban area can be protected and transformed into wildlife habitat and outdoor recreation space. Instead of land preservation, some organizations are protecting green space for functional community use in the form of community gardens. Briggs Avenue Community Garden in Durham allows community residents of all ages to come together and collectively grow and manage a garden. Community gardens have the potential to be cultivated in different manners. Whether it is a produce garden, flower garden, pollinator garden, or simply a patch of green space for citizens to unwind in, community gardens provide an educational and recreational resource to all residents.

Conservation Tactic 2-B: Bird Conservation

Objective

One of the main goals of creating an Urban Habitat Improvement Plan is to find ways to support healthy wildlife populations in cities, with respect to human populations. As more wildlife species head toward population decline, urban areas can take steps toward mitigating the effects of urbanization on wildlife. Activities centered on bird conservation can be a manageable long-term community project. This type of project would help connect people to nature through hands-on educational actions.

Actions

From Conservation Tactic 1-B, TLC can identify habitats of conservation importance. Green spaces in these areas would be ideal for a wildlife conservation community project because these lands already reflect a need for preservation. TLC can coordinate a bird conservation program with neighborhoods and communities surrounding the green space. Bird conservation activities can be implemented on TLC's lands or other urban green spaces. A community project that incorporates wildlife conservation is the placement of nesting structures in private backyards or public gardens. Nesting structures can help provide territorial space and increase population numbers in sensitive habitats ("Wildlife of Arlington", 2011). In addition, observational information can be gathered from nesting bird boxes and allude to the types of birds that are passing through and breeding in the city. Urban green spaces often serve as stopover sites for migratory birds so additional nesting structures can support migrating populations. A hands-on activity such as building nesting structures would bring together local residents and promote a conservation ethic within the community. Additional information on building nesting bird boxes can be found here: <http://www.allaboutbirds.org/page.aspx?pid=1139>

The Arlington Natural Heritage Resource Inventory Technical Report suggests that wild bird management can be supplemented with an invasive plant removal program. Removing invasive plants would help restore degraded habitats into more natural habitats for birds (“Wildlife of Arlington”, 2011). As a result, natural habitats can provide better quality food and shelter for birds. These projects can be implemented in conjunction with Conservation Tactic 2-A since nesting structures can be incorporated into urban gardens as well as invasive plant removal. Another conservation strategy included in the Arlington technical report is periodic monitoring of extant wildlife populations. Avian monitoring can be conducted on urban sites in an effort to document urban bird species. TLC can partner with local scientists or universities to conduct these studies on TLC’s urban green spaces.

Conservation Tactic 2-C: Community Tree-Planting

Objective

Urban green spaces provide recreational, environmental, and health benefits for city residents. Parks and gardens with native vegetation and diverse tree species contribute to the overall success of a well-designed green space. Trees play an important role in cities and offer several benefits that include: reducing the urban heat island effect, increasing property values, mitigating air pollution, providing natural wildlife habitat, and enhancing neighborhood aesthetics and quality. Unfortunately, rapid urbanization has led to a recent trend in deforestation. However, TLC can initiate tree-planting efforts to help support and promote a green city. Tree-planting as a community project is also a collaborative activity for residents seeking to revitalize their urban neighborhoods.

Actions

Establishing an advisory group that can guide communities on tree care follows the Newark Master Plan's conservation strategy for maintaining a healthy tree canopy. TLC employs staff members knowledgeable in forestry management; therefore TLC can take the lead on advising communities on best practices for tree care. Similarly, Openlands has a TreeKeepers program, which is an 8-day course that trains volunteers in tree planting and urban forestry practices (A. Szwak, personal communication, January 5, 2015). TLC can train volunteers as well and work with communities they have previously partnered with. In addition, Trees Across Durham is a city partnership program that has planted 1,089 trees in 2014, including 400 trees at local schools ("Trees Across Durham", 2015). This program follows the city's strategic plan to improve the quality of neighborhoods and can be a potential partnership for TLC. It is important that tree-planting efforts are targeted to priority locations, which can be established from Conservation Tactic 1-B. Along with important habitats, priority locations should also be streets, corridors, or greenways that connect neighborhoods to parks, and residential or business areas where people participate in volunteer tree stewardship activities ("Newark Master Plan Volume I", 2012).

Conservation Tactic 2-D: Pollinator Gardens

Objective

Pollinator species, such as bees and butterflies, contribute to successful crop growth in community gardens and urban green spaces (Matteson & Langellotto, 2009). A pollinator garden would serve as a community project that offers shelter for wildlife, acts as an educational tool for city residents to learn about urban wildlife, and provides urban ecologists with opportunities to collect raw data on the abundance of pollinators in cities. Pollinator gardens can be used to

examine the effects of urbanization on insects, and address ecological questions such as whether shifting toward urban agriculture is a viable solution to honeybee colony collapse disorder. Building pollinator gardens with communities is an effective way to teach the public about the importance of healthy ecosystems.

Actions

From Conservation Tactic 1-B, TLC can identify habitats of conservation importance. Green spaces in these areas would be ideal for a wildlife conservation community project because these lands already reflect a need for preservation. The Arlington Wildlife Technical Report states that butterfly gardens do not require large areas because butterflies are highly mobile (“Wildlife of Arlington”, 2011). However, native host and food plants are necessary to attract butterflies and should be planted in shaded and open areas. Integrating native plants into other urban garden community projects is a fiscally conservative way to provide successful pollinator habitat.

Creating natural habitat for bees can be beneficial for local vegetation and local bee populations. TLC can partner with local beekeepers and provide space on their urban lots for beehives. Certain bee species nest in the ground, particularly in sandy soils. These species are attracted to parks where sand has been artificially placed for recreational activities. The Arlington Wildlife Technical Report suggests that nesting habitat be constructed away from recreational amenities (“Wildlife of Arlington”, 2011). TLC can build nesting habitat for bees in urban gardens or other TLC-owned urban green spaces with less foot traffic. To construct these nests, soil pits should be dug out to a depth of 2 feet and then filled with a mixture of sand and loam (“Wildlife of Arlington”, 2011). Maintenance of pollinator gardens would be minimal and

limited to the cultivation of native plants and the removal of accumulated vegetation on the surface of bee nesting sites.

Addressing potential barriers

In order for community projects to be successful, they must be managed in suitable locations without creating a nuisance for surrounding neighbors. Urban gardens must be permitted, as well as wildlife conservation activities that may take place on public lands. It is also important to understand city land use and zoning regulations. TLC may petition city governments to amend zoning ordinances in order to support and protect new urban gardens and community project sites.

Another barrier to urban habitat conservation is the hesitation from communities to work with outside participants. It is important to foster goodwill with new communities and strengthen relationships while collaborating on community projects. This is why community outreach and public awareness, which will be discussed in Conservation Strategy #3, are valuable tools for engaging the community. As a well-known organization in the Triangle region, TLC can reach out to new communities in order to integrate the organization into an urban network. Public opinion polls and membership surveys may be useful in this situation for gauging community interest and seeking new partnerships. Gaining community support would also be beneficial when developing projects that may require a public forum or public review process. Connecting common ideals, beliefs, and cultures is a surefire way to enhance neighbor-to-neighbor relationships.

The City of Durham offers several grant programs that may offset funding challenges for TLC. Durham's Open Space and Trails Commission provides matching grants for community projects on parkland purchases, trail building, and garden development. The organization Keep

Durham Beautiful also works with the City to provide small grants for beautification projects, including tree and park adoption programs.

Conservation Strategy #3: Public Awareness

Goals:

- Raise public awareness of urban environmental issues
- Inform the public on wildlife in urban areas by providing easily-accessible materials
- Address the importance of reducing urban sprawl through the development of green infrastructure

Purpose:

As more conservation groups and scientists begin to pay attention to urban areas, it is important for public citizens to also understand the residual issues in order to collectively tackle this national problem. There is a lack of public information on urban ecology and it would be valuable for the public to receive educational information from a credible source in the community, such as TLC. Citizens can benefit from knowing how to shift toward a greener city. Through public awareness programs, TLC can emphasize the importance of finding an environmental compromise within cities, such as using built structures as biodiversity habitats. In addition, through these programs, TLC can open up doors to new members and donors, and bring about public attention to the organization.

Conservation Tactic 3-A: Urban Environmental Communications Outreach

Objective

General awareness of urban environmental issues is needed for public support of conservation actions. Public awareness also allows people to understand the changes that TLC and other conservation groups are implementing in communities. An urban environmental

communications outreach program would be an effective way to engage the public and connect people to the environment. This type of program aims to introduce the public to urban environmental issues by providing concise facts and tips for independent conservation actions. Spreading awareness on environmental issues can encourage environmental literacy and instill conservation values. It is also important for the public to recognize that by taking simple steps and small measures, they can enforce significant environmental change in their own communities and backyards.

Actions

TLC publishes a monthly e-newsletter for members and the public that primarily consists of upcoming events, blog posts, and news updates. As TLC shifts toward urban environmental conservation, TLC can include information on urban environments in the monthly newsletter to increase public awareness on the subject. This type of outreach brings a diverse scope of topics to the newsletter and engages old and new members alike. Suggested urban environmental topics include but are not limited to:

- Native habitat loss
- Importance of urban green space
- Urban heat island effect and trees
- Urban biodiversity

A “How You Can Help” section that would provide tips for solo conservation can accompany these topics. Suggested tips include:

- Planting native trees and shrubs
- Limiting the amount of mowing
- Contact information for dealing with injured wildlife

- Building bird and bat houses
- Minimizing human and wildlife conflict

These tips not only allow members to take action on their own but also give those who reside in urban and suburban areas opportunities to participate in environmental activities in their communities without traveling to a nature preserve. In addition, an urban environmental communications outreach program would help TLC partner with other non-profit organizations, such as wildlife rehabilitation centers or outdoor education programs, by connecting them to members through the newsletter. To reach out to non-TLC members and the general public, TLC should present information on urban environmental issues in public forums, neighborhood venues, and media (Robers & Todd, 2010). TLC can also create educational programs and partner with local schools. Likewise, Openlands has multiple educational programs that cover a wide range of environmental awareness activities such as birding (Birds in My Neighborhood), developing school gardens for environmental curriculum (Building School Gardens), and natural history education (Eco-Explorations) (“What We Do”, n.d.). These types of projects not only educate the local community on urban environmental issues, but also engage residents in local resource protection. Public outreach would also help TLC receive feedback from city residents about what environmental changes they would like to see take place.

Conservation Tactic 3-B: Occupational Community Partnership

Objective

TLC can create partnerships with the occupational community (i.e. businesses and agencies) to expand public awareness. There is significant urban conservation potential in the business community because commercial buildings are abundant in downtown areas and represent a significant portion of urban land usage. Including this sector in environmental

protection would be one way to address the environmental consequences of urban development. As urban growth continues to rise, efficient use of already developed land can be a simple solution for combating environmental problems associated with urban development. To achieve this, TLC can work with businesses to encourage and support sustainability and urban habitat conservation in cities. Businesses are also a good venue for green projects because business parks and commercial buildings provide three valuable properties for biodiversity. These factors are: accessible spaces that can be turned into gardens, buildings with expansive surfaces that can be converted into green roofs, and the tendency to be silent and isolated in the evening which benefits wildlife (Hunter, 2007). Introducing green projects to the business community can also help TLC develop new partnerships and corporate sponsors.

Actions

Working with the occupational community is a great way to develop demonstration projects that promote urban sustainability (“2030 Comprehensive Plan”, 2009). These projects may include green roofs, rain gardens, and other green infrastructural changes that use best practices management. Connecting with the business sector on these projects is one way to incorporate urban conservation at the workplace. Similar to green spaces in communities, these green designs in business parks improve work quality and employee happiness (Hunter, 2007). If designed properly, green roofs also provide flexible and productive ecosystems on small surface areas. These types of green infrastructure projects protect urban ecosystems and allow for new partnerships with corporate sponsors and city planners. Several of the community projects from Conservation Strategy #2 may be implemented in or near business parks, such as urban gardens and bird conservation. Working with the business community is an efficient way to utilize developed city space for conservation measures. In addition to businesses, TLC can work with

local land management agencies, to incorporate habitat management within their broader recreational missions. This is a strategy that Openlands implements, as they sponsor the Next Century Conservation Plan, a long-term conservation initiative for Cook County, Illinois (A. Szwak, personal communication, January 5, 2015).

Addressing potential barriers

Similar to the challenges anticipated in Conservation Strategy #2, a potential barrier for this conservation strategy is the hesitation from the business community to partner with TLC. Without developing relations of trust and reciprocity, it may be difficult for TLC to collaborate with new associates. To address this challenge, TLC should be prepared to offer benefits for collaboration with businesses, or be knowledgeable of the incentives that the City offers (e.g. tax write-offs, rebates, etc.) for businesses involved in sustainable practice. As previously mentioned, public opinion polls and membership surveys may also be useful in this situation for seeking new partnerships.

Action Plan Conclusion

This Urban Habitat Improvement Plan provides guidelines for TLC to initiate urban habitat conservation work in the Triangle region. Recommendations in this plan are influenced by comparisons of nationwide city comprehensive plans, a case study on Openlands, an understanding of TLC's vision and goals, and an extensive literature review of current urban conservation tools and approaches. The three main conservation strategies in this document are: securing vacant lots, creating community projects, and spreading public awareness on urban habitat conservation. Ideally, city managers and conservation organizations will look to similar action plans when considering urban habitat conservation strategies. It is hoped that this plan

helps TLC address the effects of urbanization and continue the dialogue of undertaking other urban environmental issues.

X. Closing Statement

Urbanization is seen as a necessary step for human advancement, but rapid development negatively impacts human health as well as wildlife conservation. Supporting literature reveals that urban areas can be improved upon with the creation of green spaces, as these natural habitats increase human well-being and provide conservation value. Therefore, in order to fully address urban habitat conservation, implemented tools and techniques must be able to serve a dual purpose of continuing human development while alleviating environmental consequences. Equally important are public awareness and outreach efforts that educate the public on urban environmental matters and involve community residents in conservation projects. Ideally, an urban conservation plan would include the aforementioned approaches, consider the needs and roles of all stakeholders, and provide action steps for long-term cooperation and implementation success. It is hoped that a comprehensive urban habitat conservation plan that combines multiple approaches can help organizations, such as TLC, and city managers work successfully to ensure long-term environmental protection.

XII. References

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XIII. Figures and Tables

Figure 1. Population Density of Cities

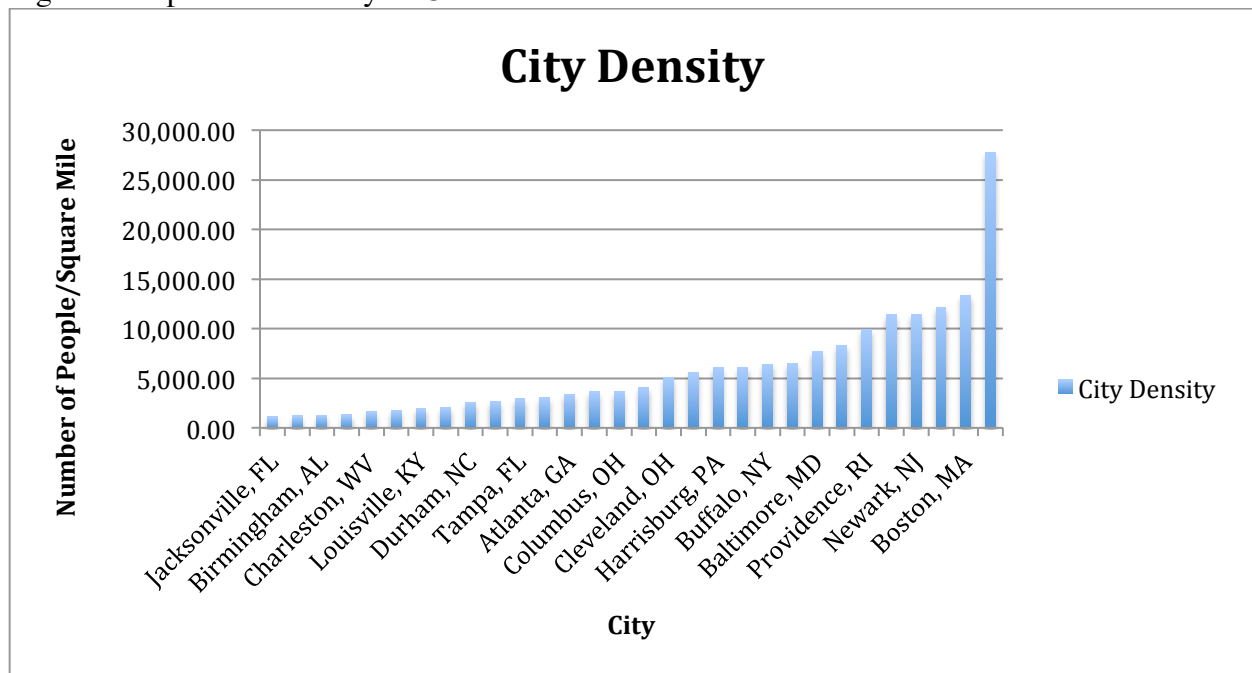


Figure 2. Weighted Percentages of City Scores (Wildlife Component)

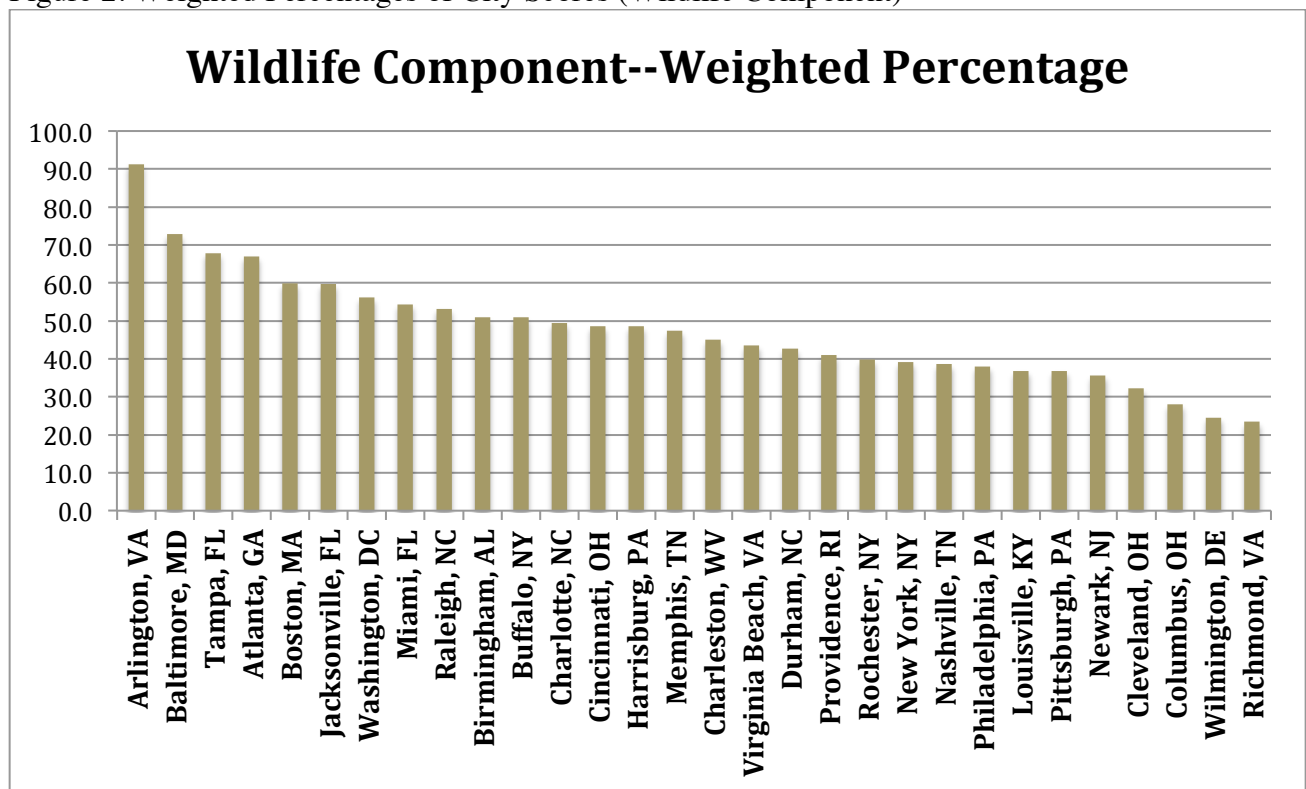


Figure 3. Weighted Percentages of City Scores (Green Space Component)

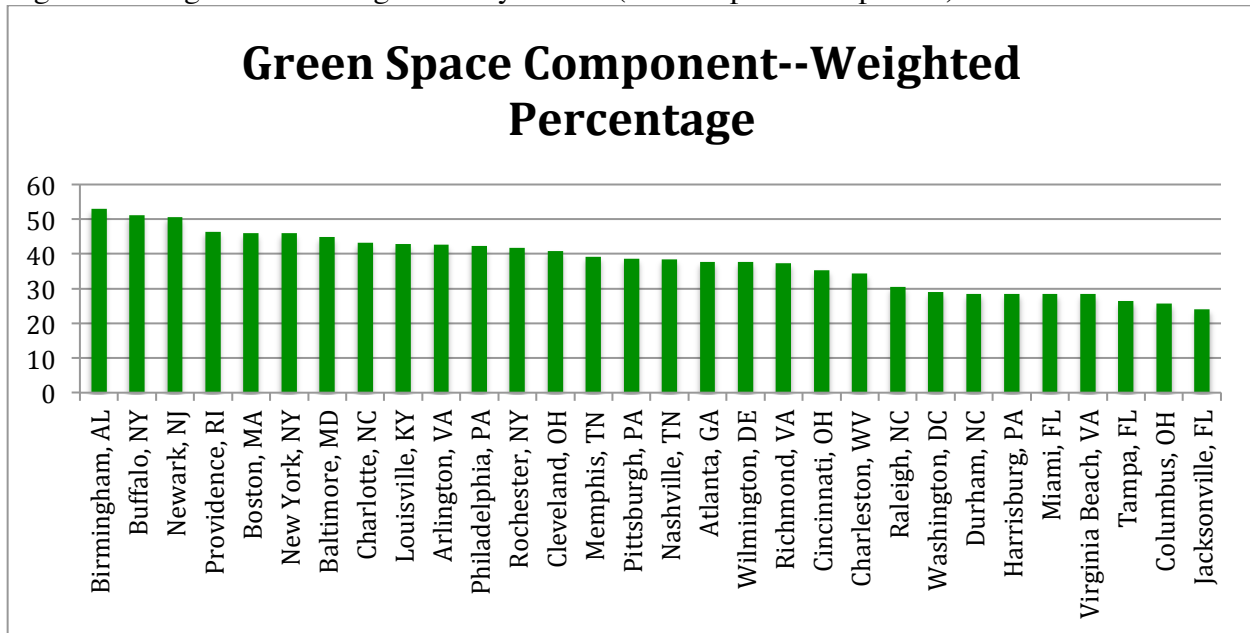


Figure 4. Map of the population density and percent green space in Durham (EnviroAtlas, 2014)

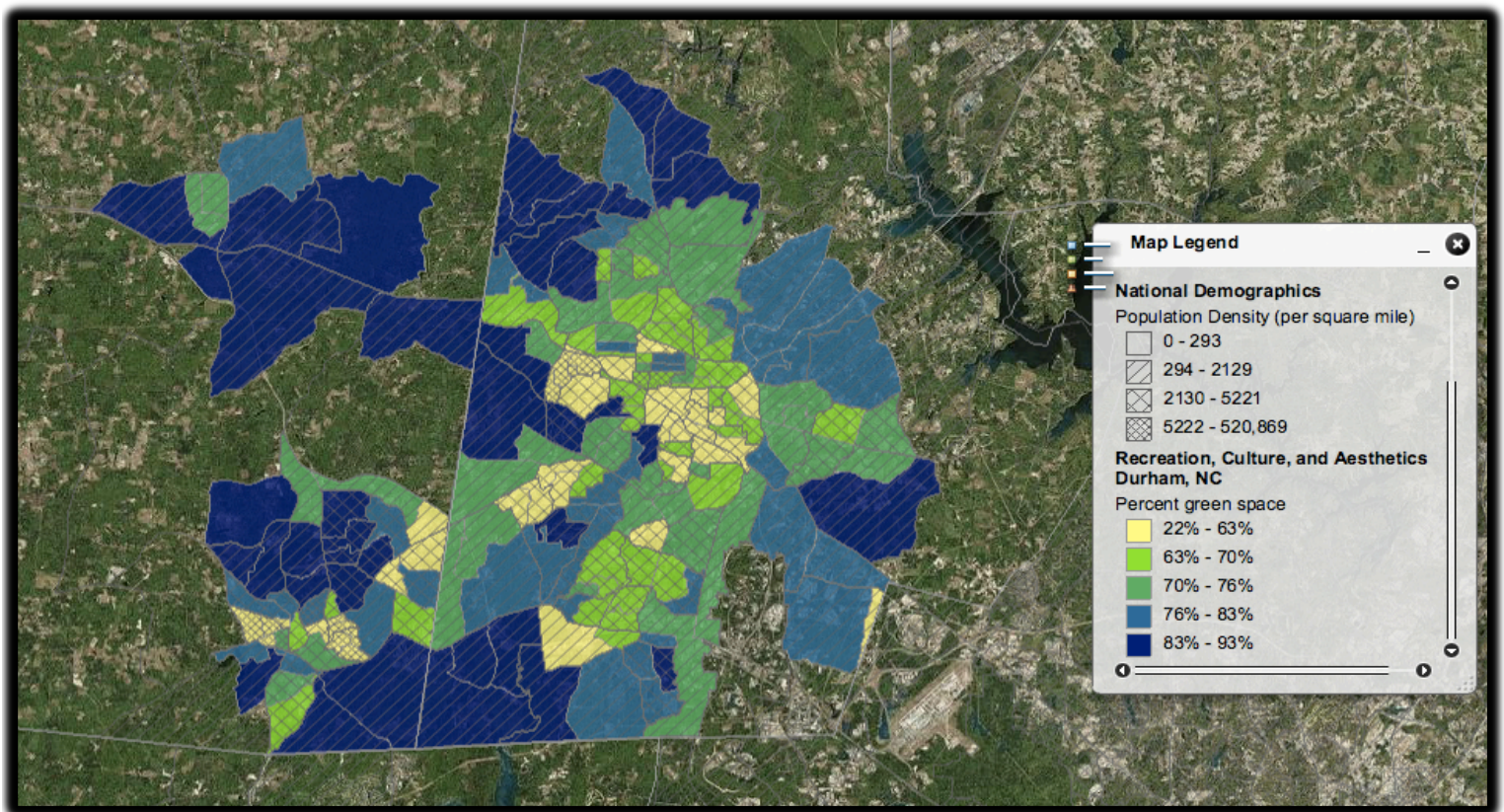


Figure 5. Map of percent tree cover and water bodies in Durham (EnviroAtlas, 2014)

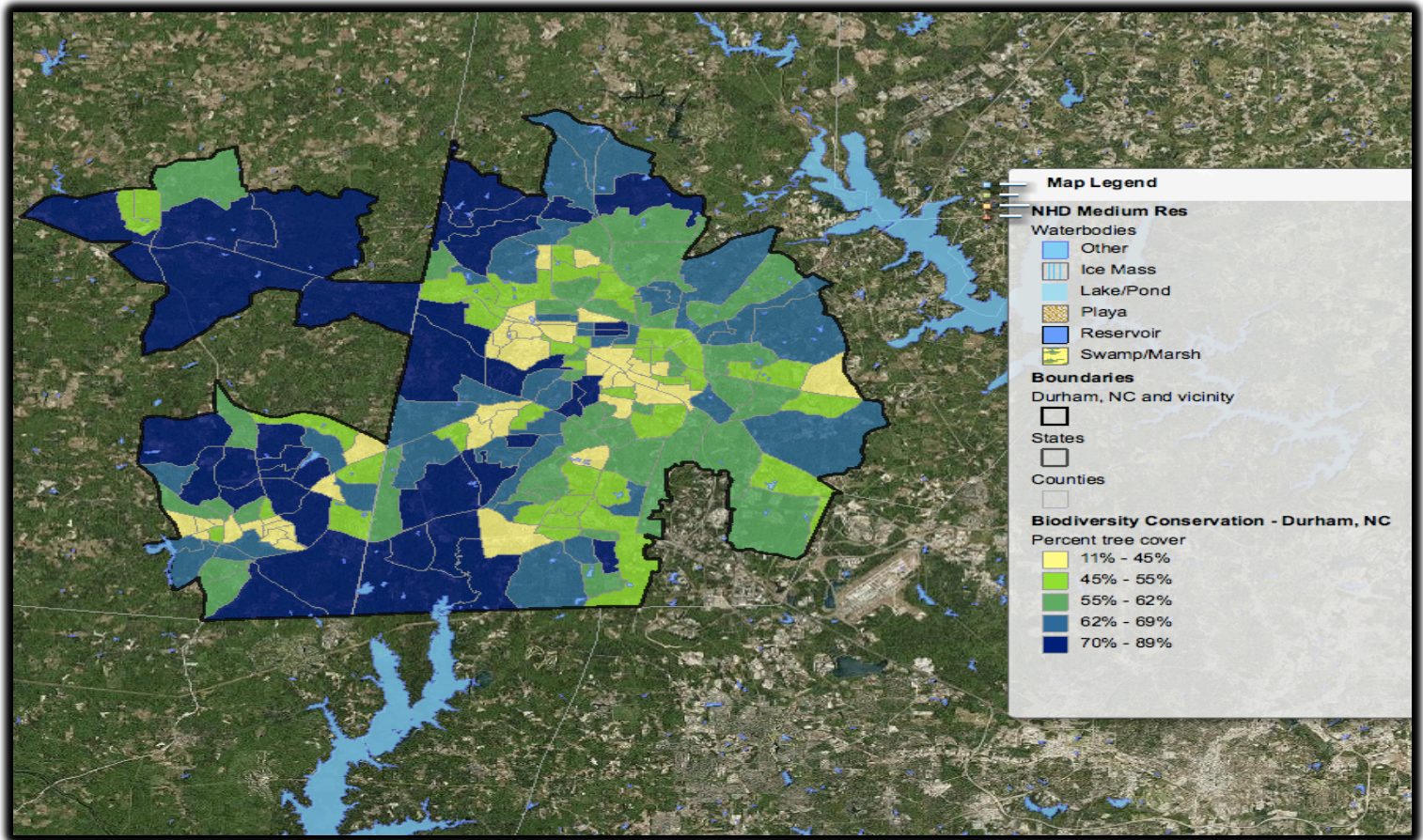


Table 1. List of Sampled Cities With Respective Populations and Densities

City*, State	Population	Density (people/sq mi)
Arlington, VA	227,146	8,309
Atlanta, GA	447,841	3,382
Baltimore, MD	622,104	7,671.50
Birmingham, AL	201,332	1,290
Boston, MA	645,966	13,340
Buffalo, NY	259,384	6,436.20
Charleston, WV	51,400	1,630.70
Charlotte, NC	792,862	2,663.20
Cincinnati, OH	296,943	3,624
Cleveland, OH	396,815	5,107
Columbus, OH	787,033	3,624
Durham, NC	245,550	2,595
Harrisburg, PA	49,528	6,114
Jacksonville, FL	842,583	1,100.10
Louisville, KY	756,832	1,924.00
Memphis, TN	653,450	2,053
Miami, FL	419,777	12,139.50
Nashville, TN	626,681	1,200
New York, NY	8,405,837	27,778.70
Newark, NJ	277,140	11,458.30
Philadelphia, PA	1,553,165	11,379.60
Pittsburgh, PA	305,841	5,540
Providence, RI	177,994	9,950
Raleigh, NC	431,746	3,023.40
Richmond, VA	214,114	1,318.40
Rochester, NY	210,358	6,132.90
Tampa, FL	347,645	2,969.60
Virginia Beach, VA	448,479	1,759
Washington, DC	646,449	4,066
Wilmington, DE	71,292	6,522

Table 2. Evaluation Scoring Breakdown

Category A: Wildlife Conservation	MaxPoints	%
Sub-category 1: Species Benefits	65	38.01169591
Sub-category 2: Ecosystem Benefits	16	9.356725146
Sub-category 3: Management	40	23.39181287
Sub-category 4: Public Outreach	30	17.54385965
Sub-category 5: Partnerships and Stakeholders	20	11.69590643
Total	171	100
Category B: Green Space Development	MaxPoints	%
Sub-category 1: Natural Resources Management	96	50.00
Sub-category 2: Community Engagement	47	50
Total	143	100

Table 3. Special Status Species in Durham County and Adjacent Counties

Common Name	Scientific Name	Status	County of Occurrence (USFWS 2014)
American eel	<i>Anguilla rostrata</i>	NC Special Concern Species	Granville, Durham
Atlantic pigtoe	<i>Fusconaia masoni</i>	NC Special Concern Species	Person, Granville, Durham
Bachman's sparrow	<i>Aimophila aestivalis</i>	NC Special Concern Species	Chatham
Bald eagle*	<i>Haliaeetus leucocephalus</i>	Federally Threatened	Durham, Granville, Orange
Brook floater	<i>Alasmidonta vericosa</i>	NC Special Concern Species	Granville
Cape Fear shiner	<i>Notropis mekistocholas</i>	Federally Endangered	Chatham
Carolina darter	<i>Etheostoma collis</i>	NC Special Concern Species	Durham, Person, Granville
Carolina madtom	<i>Noturus furiosus</i>	NC Special Concern Species	Granville, Durham
Carolina redhorse	<i>Moxostoma sp. 'Carolina'</i>	NC Special Concern Species	Chatham
Chowanoke Crayfish*	<i>Oronectes virginienensis</i>	NC Special Concern Species	Granville
Dwarf wedge mussel	<i>Alasmidonta heterodon</i>	Federally Endangered	Wake, Person, Granville, Orange
Green floater	<i>Lasmigona subviridis</i>	NC Special Concern Species	Person, Granville, Durham
Northern long eared bat*	<i>Myotis septentrionalis</i>	Federally Threatened	Granville
Panhandle pebblesnail	<i>Somatogyrus virginicus</i>	NC Special Concern Species	Durham
Pinewoods shiner	<i>Lythrurus matutinus</i>	NC Special Concern Species	Granville, Person, Durham
Red cockaded woodpecker	<i>Picoides borealis</i>	Federally Endangered	Chatham, Wake, Orange
Roanoke bass	<i>Ambloplites cavifrons</i>	NC Special Concern Species	Granville, Person, Durham
Savannah lilliput	<i>Toxolasma pullus</i>	NC Special Concern Species	Orange
Septima's clubtail*	<i>Gomphus septima</i>	NC Special Concern Species	Durham
Southeastern bat*	<i>Myotis austroriparius</i>	NC Special Concern Species	Wake
Southern hognose snake*	<i>Heterodon simus</i>	NC Special Concern Species	Wake
Yellow lampmussel	<i>Lamslis cariosa</i>	NC Special Concern Species	Person, Durham
Yellow lance	<i>Elliptio lanceolata</i>	NC Special Concern Species	Granville

* Species with potential to use urban habitats

XIV. Appendices

Appendix 1. Wildlife Conservation Component Evaluation Template (USFWS, 2014; USFWS, 2009)

Wildlife Conservation Evaluation (adapted from the USFWS Cooperative Endangered Species Fund Grant Program 2014 and USFWS Southeast Fisheries Habitat Project Ranking Criteria 2009)	Points
Conservation Benefits	
1. Does the plan contribute to conservation of federally or state listed; or recreationally and economically important (includes unlisted -- candidate, proposed, State-listed, and others) species?	
Federally or state listed, endangered, threatened, or special concern species	
a. 1 species (1 pt)	
b. 2-5 species (5 pts)	
c. 6-10 species (10 pts)	
d. 11+ species (15 pts)	
Recreationally and/or economically important species	
a. 1 species (1 pt)	
b. 2-5 species (5 pts)	
c. 6-10 species (10 pts)	
d. 11+ species (15 pts)	
	/30
3. What is the chance of long term success of the plan?	
a. High: Conservation action will result in long term benefit to recovery; applicant demonstrates commitment to adaptive management and regular maintenance (20 pts)	
b. Medium: Conservation action will result in moderate term benefit to recovery; applicant demonstrates commitment to adaptive management and regular maintenance (15 pts)	
c. Medium-low: Conservation action will result in short term benefit to recovery; applicant demonstrates commitment to adaptive management and regular maintenance (10 pts)	
d. Low: Conservation action will result in short term benefit to recovery, but applicant does not demonstrate commitment to adaptive management and regular maintenance (5 pts)	
c. None: Conservation action is unlikely to result in any benefit and applicant does not demonstrate a commitment to adaptive management and regular maintenance (0 pts)	
	/20
4. What are the benefits to conservation?	
a. High: 75% or greater of the species' range-wide habitat or an essential piece of habitat will be protected; or, a major population necessary for recovery may be protected; or, a source population that provides individuals for future emigration is protected; or, major threats to the species will be eliminated (15 pts)	
b. Medium (10 pts)	
c. Low: 20% or less of the species' range-wide habitat or an essential piece of habitat will be protected; or, individual populations to be covered contribute little to the overall recovery of the species; or, threats to the species are not imminent (5 pts)	
	/15

5. What are the ecosystem benefits?	
Function	
a. Habitat fills a critical role in the life cycle of the primary species being protected (8 pts)	
b. Habitat requires little or no management to provide benefits to the primary species being protected (4 pts)	
Connectivity	
a. Habitat links two existing protected areas together or is adjacent to existing protected areas, to reduce habitat fragmentation (8 pts)	
	/16
	Sub-Total: /81
Management Assets	
1. Can major aspects of the plan be completed within 12 months of receiving funding?	
a. Yes (10 pts)	
b. No (0 pts)	
	/10
2. Is evaluation and monitoring included in the proposal?	
a. >3 year period of monitoring and evaluation included (20 pts)	
b. >1-3 year period of monitoring and evaluation included (15 pts)	
c. 1 year period of monitoring and evaluation included (10 pts)	
d. <1 year period of monitoring and evaluation included (5 pts)	
e. no monitoring or evaluation included (0 pts)	
	/20
3. What is the level of public access/visibility?	
a. Unlimited access/visibility (15 pts)	
b. Limited access/visibility (e.g. Only on week days) (10 pts)	
c. Minimal visibility (e.g. only few days per year, largely for visibility or outdoor classroom demonstrations) (5 pts)	
d. No access or discriminated access (e.g. Only accessible by members) (0 pts)	
	/15
4. Does the plan contribute to the education or outreach goals of the community, have value as a demonstration plan, or have great potential to foster/generate a community conservation ethic through citizen involvement?	
a. High (e.g. long term, far reaching education, actively managed websites, active outdoor classrooms, permanent kiosks) (15 pts)	
b. Medium (e.g. lengthy media coverage, periodic outdoor classrooms, high distribution manuscript/journals/pamphlets) (10 pts)	
c. Low (e.g. one time news release or low distribution manuscript/journals/pamphlets) (5 pts)	
d. None (0 pts)	/15
5. Does the plan restore/enhance unique habitat that has a high per acre/mile value (e.g. pollinator habitat or migratory bird stopover habitat)?	
a. Yes (10 pts)	

b. No (0 pts)	
	/10
	Sub-Total: /70
Partnerships and Stakeholders	
1. Are there unique partnership aspects? Does the plan foster stakeholder participation and contribution?	
a. Yes; >10 stakeholders (20 pts)	
b. Yes; 6-10 stakeholders (10 pts)	
c. Yes; 1-5 stakeholders (5 pts)	
d. No (0 pts)	
	Sub-Total: /20
	Total: /171

Appendix 2. Green Space Development Evaluation Template (Gallagher, 20012; Kenney et al., 2011)

Green Space and Parks Evaluation (adapted from Kenney et al. and Oregon Statewide Comprehensive Outdoor REcreation Plan)	Points
Natural Resources Management (note: for the trees, a lot of the criteria are for existing habitats and studies, not necessarily for plans)	
1. Is there a complete inventory of all the trees in order to direct management?	
a. Low: No inventory (1 pt)	
b. Moderate: Complete or sample-based inventory of publicly owned trees (2 pts)	
c. Good: Complete inventory of publicly owned trees and sample-based inventory of privately-owned trees (3 pts)	
d. Optimal: Complete inventory of publicly owned trees and sample-based inventory of privately-owned trees included in citywide GIS (4 pts)	
2. Is there a complete inventory of community canopy cover for high resolution assessments?	
a. Low: No inventory (1 pt)	
b. Moderate: Visual assessment(2 pts)	
c. Good: Sampling of tree cover using aerial photographs or satellite imagery(3 pts)	
d. Optimal: Sampling of tree cover using aerial photographs or satellite imagery included in citywide GIS (4 pts)	
3. Is there a citywide management plan?	
a. Low: No plan (1 pt)	
b. Moderate: Existing plan limited in scope and implementation (2 pts)	
c. Good: Comprehensive plan for publicly owned intensively- and extensively-managed forest resources are accepted and implemented (3 pts)	
d. Optimal: Strategic multi-tiered plan for public and private intensively- and extensively-managed forest resources accepted and implemented with adaptive management mechanisms pts)	
4. Is there municipality-wide funding that supports a citywide management plan?	

a. Low: Funding for reactive management (1 pt)	
b. Moderate: Funding to optimize existing urban forest (2 pts)	
c. Good: Funding to provide for net increase in urban forest benefits (3 pts)	
d. Optimal: Adequate private and public funding to sustain maximum urban forest benefits (4 pts)	
5. Is there adequate city staffing available to implement citywide management plan?	
a. Low: No staff (1 pt)	
b. Moderate: No training of existing staff (2 pts)	
c. Good: Certified arborists and professional foresters on staff with regular professional development (3 pts)	
d. Optimal: Multidisciplinary team within urban forestry unit (4 pts)	
6. Is there a tree establishment and planning program?	
a. Low: Tree establishment is <i>ad hoc</i> . (1 pt)	
b. Moderate: Tree establishment occurs on an annual basis (2 pts)	
c. Good: Tree establishment is directed by needs derived from a tree inventory (3 pts)	
d. Optimal: Tree establishment is directed by needs derived from a tree inventory and is sufficient to meet canopy cover objectives (4 pts)	
7. Are habitats suitable for trees?	
a. Low: Trees are planted without consideration of site conditions (1 pt)	
b. Moderate: Tree species are considered in planting site selection (2 pts)	
c. Good: Community-wide guidelines are in place for the improvement of planting sites and the selection of suitable species (3 pts)	
d. Optimal: All trees planted in sites with adequate soil quality and quantity, and growin space to achieve their genetic potential (4 pts)	
8. What is the maintenance level of publicly owned trees?	
a. Low: No maintenance(1 pt)	
b. Moderate: Maintained on a request/reactive basis. No systematic pruning. (2 pts)	
c. Good: Systematically maintained on a cycle longer than five years (3 pts)	
d. Optimal: All mature trees are maintained on a five year cycle. All immature trees are structurally pruned. (4 pts)	
9. Is there a tree risk management plan?	
a. Low: No tree risk assessment/remediation program (1 pt)	
b. Moderate: Sample-based tree inventory including general tree risk information. (2 pts)	
c. Good: Complete tree inventory includes detailed tree failure risk ratings; risk abatement program is in effect eliminating hazards within a maximum of one month from confirmation of hazard potential (3 pts)	
d. Optimal: Complete tree inventory includes detailed tree failure risk ratings; risk abatement program is in effect eliminating hazards within a maximum of one week from confirmation of hazard potential. (4 pts)	
10. Is there a tree protection policy?	
a. Low: No (1 pt)	
b. Moderate: Policies in place to protect public trees (2 pts)	
c. Good: Policies in place to protect public and private trees with enforcement(3 pts)	

d. Optimal: Integrated municipal wide policies that ensure the protection of trees on public and private land are consistently enforced. (4 pts)	
11. Are there management plans for publicly owned natural areas?	
a. Low: No stewardship plans or implementation in effect (1 pt)	
b. Moderate: Reactionary stewardship in effect to facilitate public use (2 pts)	
c. Good: Stewardship plan in effect for each publicly owned natural area to facilitate public use (3 pts)	
d. Optimal: Stewardship plan in effect for each publicly owned natural area focused on sustaining the ecological structure and function of the feature (4 pts)	
12. Is there adequate canopy cover?	
a. Low: The existing canopy cover equals 0-25% of the potential (1 pt)	
b. Moderate: The existing canopy cover equals 25-50% of the potential (2 pts)	
c. Good: The existing canopy cover equals 50-75% of the potential. (3 pts)	
d. Optimal: The existing canopy cover equals 75-100% of the potential (4 pts)	
13. Is there even age distribution of trees in the community?	
a. Low: Any Relative DBH class represents more than 75% of the tree population (1 pt)	
b. Moderate: Any Relative DBH class represents between 50% and 75% of the tree population (2 pts)	
c. Good: No RDBH class represents more than 50% of the tree population. (3 pts)	
d. Optimal: 25% of the tree population is in each of four RDBH classes (4 pts)	
14. Are there suitable species for the urban environment?	
a. Low: Less than 50% of trees are of species considered suitable for the area (1 pt)	
b. Moderate: 50-75% of trees are of species considered suitable for the area (2 pts)	
c. Good: More than 75% of trees are of species considered suitable for the area (3 pts)	
d. Optimal: All trees are of species considered suitable for the area (4 pts)	
15. Is there a genetically diverse tree population citywide?	
a. Low: Fewer than five species dominate the entire tree population citywide (1 pt)	
b. Moderate: No species represents more than 20% of the entire tree population citywide (2 pts)	
c. Good: No species represents more than 10% of the entire tree population citywide. (3 pts)	
d. Optimal: No species represents more than 10% of the entire tree population at the neighborhood level (4 pts)	
16. Are publicly owned natural areas documented?	
a. Low: No information about publicly owned natural areas (1 pt)	
b. Moderate: Publicly owned natural areas identified in a survey or document (2 pts)	
c. Good: The level and type of public use in publicly-owned natural areas is documented (3 pts)	
d. Optimal: The ecological structure and function of all publicly-owned natural areas are documented and included in the citywide GIS (4 pts)	
17. Is there integration of native vegetation?	
a. Low: No program of integration (1 pt)	
b. Moderate: Voluntary use of native species on publicly and privately-owned lands; invasive species are recognized (2 pts)	

c. Good: The use of native species is encouraged on a project-appropriate basis in both intensively and extensively managed areas; invasive species are recognized and their use is discouraged (3 pts)	
d. Optimal: The use of native species is required on a project-appropriate basis in both intensively and extensively managed areas; invasive species are recognized and prohibited (4 pts)	
18. Does your project seek to identify and acquire remnant grasslands, wetlands, streams, rivers, floodplains, greenways, etc., in order to protect/provide habitats for flora and fauna and/or to prevent erosion, sedimentation and/or to improve water quality? (1 point)	
19. Is your project committed to incorporating best management practices when designing park property including the use of native landscaping, rain gardens, bio-swales, etc.? (1 point)	
20. Has your project recently applied for grants that improve water quality and bank stabilization in wetlands, ponds, streams, etc.? (1 point)	
21. Does your project's operating budget contain regular funding for natural resource management? (1 point)	
22. Does your project have a maintenance and management plan in place for natural areas that utilizes best environmental practices for improving natural areas, exotic species control and increasing biodiversity? (2 points)	
23. Does your project try to reduce the use of fertilizers and pesticides in parks by using drought and disease-resistant native plant species and eliminating mowing in some areas? (1 point)	
24. Does your project provide a no-mow buffer of native vegetation around water bodies to reduce erosion and non-point pollution? (1 point)	
25. Does your project practice soil and landscape management techniques to control exotic species establishment? (1 point)	
26. Is landscaping around facilities designed with energy conservation in mind (e.g., windbreaks, and/or shade trees along south exposures, and/or drought tolerant native plants)? (1 point)	
27. Does your project plant trees, shrubs and evergreens in strategic locations in and around paved areas to provide shade and wind buffers? (1 point)	
28. Does your project have a native plant policy that details, identifies, and requires the planting of acceptable plant species? (1 point)	
29. Does your project have an integrated pest management program to reduce the use of pesticides within parks? (1 point)	
30. Does your project use alternative and/or biological pest control practices in place of traditional chemical solutions (e.g., use of purple loosestrife, beetles, dormant oils, etc.)? (1 point)	
31. Has your project recently applied for grants that improve water quality and bank stabilization in wetlands, ponds, and streams? (1 point)	
32. Does your project distribute educational pamphlets or have interpretative signs in place at parks that explain natural resource management practices? (2 points)	
33. Does your project use grassland or woodland restoration or bio-swales to reduce maintenance costs, control erosion or promote wildlife habitat? (1 point)	
34. Does your project have demonstration areas landscaped with native plants within golf courses or other more traditional park landscapes? (1 point)	

35. Does your project incorporate native planting schemes into the landscape of your offices, parks and facilities? (1 point)	
36. Is your project responsible to private landowner activities that impact your natural area management (encroachment, dumping, private waterway ownership, etc.)? (1 point)	
37. Has your project developed a green waste/composting benchmark and established this as a park maintenance standard? (1 point)	
38. Has your project developed and implemented an urban tree and forest management and development plan? (1 point)	
39. Has your project implemented a program for the removal of non-natives from natural and open space areas including long-term maintenance of the site? (1 point)	
40. Does your project have or sponsor a community garden or P-Patch program to educate the public on how to garden and grow their own food? (1 point)	
41. Does your project utilize recycled water for landscape irrigation? (1 point)	
42. Has your project developed a soil management plan with regular soil testing which includes at a minimum soil texture, infiltration rate, pH, soluble salts and sodium? (1 point)	
43. Does your project ensure that park and recreation uses adjacent to natural areas, open space and/or sensitive habitat are compatible? (1 point)	
	/96
Community Framework	
1. What is the level of public agency cooperation?	
a. Low: Conflicting goals among departments and/or agencies (1 pt)	
b. Moderate: Common goals but no cooperation among departments and/or agencies (2 pts)	
c. Good: Informal teams among departments and/or agencies are functioning and implementing common goals on a project-specific basis (3 pts)	
d. Optimal: Municipal policy implemented by formal interdeparmtental/interagency working teams on all municipal projects (4 pts)	
2. What is the involvement level of large private and institutional land holders?	
a. Low: Ignorance of issues (1 pt)	
b. Moderate: Educational materials and advice available to landholders (2 pts)	
c. Good: Clear goals for tree resource by landholders. Incentives for preservation of private trees. (3 pts)	
d. Optimal: Landholders develop comprehensive tree management plans (including funding) (4 pts)	
3. What is the involvement level of green industries?	
a. Low: No cooperation among segments of the green industry. (1 pt)	
b. Moderate: General cooperation among green industry. (2 pts)	
c. Good: Specific cooperative arrangements, such as purchase certificates for "right tree in the right place" (3 pts)	
d. Optimal: Shared vision and goals including the use of professional standards (4 pts)	
4. What is the level of neighborhood action?	
a. Low: No action (1 pt)	
b. Moderate: Isolated or limited number of active groups (2 pts)	
c. Good: Citywide coverage and interaction (3 pts)	

d. Optimal: All neighborhoods organized and cooperating (4 pts)	
5. What is the level of interaction between all constituencies in the benefit of urban forests?	
a. Low: Conflicting goals among constituencies (1 pt)	
b. Moderate: No interaction among constituencies (2 pts)	
c. Good: Informal and/or general cooperation (3 pts)	
d. Optimal: Formal interaction, such as a tree board with staff coordination (4 pts)	
6. What is the general public level of awareness of trees as a community resource?	
a. Low: Trees seen as a problem, a drain on budgets (1 pt)	
b. Moderate: Trees seen as important to the community (2 pts)	
c. Good: Trees acknowledged as providing environmental, social, and economic services. (3 pts)	
d. Optimal: Urban forest recognized as vital to the community's environmental, social, and economic well-being (4 pts)	
7. What is the level of regional cooperation?	
a. Low: Communities cooperate independently (1 pt)	
b. Moderate: Communities share similar policy vehicles (2 pts)	
c. Good: Regional planning is in effect (3 pts)	
d. Optimal: Regional planning, coordination, and/or management plans are in effect (4 pts)	
8. Does your project provide access for the public to recreate in sensitive natural/preserved areas using boardwalks, trails, fishing piers, platforms, etc.? (1 point)	
9. Does your project increase public awareness of the benefits of natural/preserved areas with interpretive signs, educational brochures/posters and programs? (2 points)	
10. Does your project partner with other organizations and/or local developers in order to provide information to prospective home buyers on best practices for living around natural areas or man-made water detention sites? (1 point)	
11. Does your project's planning department and natural resource maintenance staff work together on site plans for traditional parks and facilities landscapes? (1 point)	
	/33
<i>Educational Programming</i>	
1. Does your project own and operate a nature center? If not, does your project provide regular nature education or nature interpretive programming for residents within its parks or facilities? (1 point)	
2. Does your project partner with local groups to provide specific programming (e.g., Audubon Society, local garden clubs, Master Gardeners, etc.)? (2 points)	
3. Does your project provide programs for the public regarding environmental lifestyle choices/environmental living (e.g. native or organic gardening, living lightly, composting, etc.)? (1 point)	
4. Are educational programs, pamphlets, news articles or cable television utilized to inform residents and homeowner associations of alternative landscape options? (1 point)	
5. Do staff members plan projects and purchase supplies using written environmental criteria that might include minimal packaging, recycled and recyclable content, made from renewable resources, etc.? (1 point)	

6. Does your project provide recycling for facility rentals, special events and outside vendors? (1 point)	
7. Does your project have and/or support a volunteer program to aid in land management and/or environmental education? (1 point)	
8. Are program staff provided training and encouragement from supervisors in energy and resource conservation (thermostat settings, lights, recycling, etc.)? (1 point)	
9. Has your project recently applied for grants to fund environmental programs or interpretative initiatives? (1 point)	
10. Do public or special events provide opportunities for vendor and public participation in recycling efforts? (1 point)	
11. Does your project clearly communicate its energy conservation program to public officials, staff, and park/facility patrons? (2 points)	
12. Does your project promote volunteerism within parks to create opportunities for the public to be directly involved in the protection, maintenance, and enhancement of parks, natural areas and open spaces? (1 point)	
	/14
Total	/143

Appendix 3. Complete Ranking of Scored City Plans

Rank	City*, State	Score Wildlife (out of 171)	Weighted %	Rank	City*, State	Score Green Spaces (out of 143)	Weighted %
1	Arlington, VA	156	91.2	1	Birmingham, AL	63	52.9
2	Baltimore, MD	124.5	72.8	2	Buffalo, NY	65	51.2
3	Tampa, FL	91	67.8	3	Newark, NJ	69	50.6
4	Atlanta, GA	114.5	67.0	4	Providence, RI	61	46.4
5	Boston, MA	102.5	59.9	5	Boston, MA	59	45.9
6	Jacksonville, FL	102	59.6	6	New York, NY	58	45.9
7	Washington, DC	96	56.1	7	Baltimore, MD	57.5	44.8
8	Miami, FL	93	54.4	8	Charlotte, NC	57.5	43.2
9	Raleigh, NC	91	53.2	9	Louisville, KY	53	42.8
10	Birmingham, AL	87	50.9	10	Arlington, VA	61	42.6
11	Buffalo, NY	87	50.9	11	Philadelphia, PA	56	42.2
12	Charlotte, NC	84.5	49.4	12	Rochester, NY	49	41.8
13	Cincinnati, OH	83	48.5	13	Cleveland, OH	46	40.8
14	Harrisburg, PA	83	48.5	14	Memphis, TN	43	39.2
15	Memphis, TN	81	47.4	15	Pittsburgh, PA	46	38.6
16	Charleston, WV	77	45.0	16	Nashville, TN	52	38.5
17	Virginia Beach, VA	74.5	43.6	17	Atlanta, GA	50	37.7
18	Durham, NC	84.5	42.7	18	Wilmington, DE	50	37.7
19	Providence, RI	70	40.9	19	Richmond, VA	50	37.4
20	Rochester, NY	68	39.8	20	Cincinnati, OH	50	35.3
21	New York, NY	67	39.2	21	Charleston, WV	43	34.3
22	Nashville, TN	66	38.6	22	Raleigh, NC	42.5	30.4
23	Philadelphia, PA	65	38.0	23	Washington, DC	39	29
24	Louisville, KY	63	36.8	24	Durham, NC	32.5	28.5
25	Pittsburgh, PA	63	36.8	25	Harrisburg, PA	41	28.5
26	Newark, NJ	61	35.7	26	Miami, FL	36.5	28.5
27	Cleveland, OH	55	32.2	27	Virginia Beach, VA	45.5	28.4
28	Columbus, OH	48	28.1	28	Tampa, FL	47	26.4
29	Wilmington, DE	42	24.6	29	Columbus, OH	40	25.7
30	Richmond, VA	40	23.4	30	Jacksonville, FL	32	24.1

Appendix 4. Case Study Interview Questions and Consent Forms

Interview Questions

1. Does your organization adhere to specific state/county/city guidelines when it comes to conserving parcels of land? If so, what guidelines are they (please be as specific as possible)?
2. Describe one or two of your rural projects. What is the purpose of these projects? Has it been successful?
3. Describe one or two of your urban projects. What are the objectives of these projects?
4. What are some of the main challenges that arise when working on conservation initiatives in cities?
5. What are some of the differences (if any) between land trust work in rural areas versus urban areas?
6. Does your organization acquire vacant lots in urban areas? Please describe the process.
7. Would you find a comprehensive urban conservation plan to be helpful when exploring new urban projects? Why or why not?
8. What are some of your partnerships (i.e. other organizations, businesses, agencies) for urban conservation work?
9. What are some ways in which your organization incorporates habitat protection and sensitive species protection in urban areas?
10. How does your organization involve the local community in rural projects? With urban conservation projects?

Interview Consent Form

Project Title: Examining Urban Conservation Opportunities for Triangle Land Conservancy

Investigator: Charlene Wu, Master of Environmental Management candidate

Duke University

Contact Information: charlene.wu@duke.edu

Purpose

The purpose of this project is to examine existing urban conservation work and literature as a means to develop urban habitat improvement guidelines for the Triangle Land Conservancy (TLC), a non-profit land trust in Durham, N.C. Specifically, this study analyzes the need for an all-inclusive urban conservation plan that is capable of addressing all components of preserving urban environments and aims for long-term sustainability. This study involves research for a case study on how your organization conducts conservation work in urban areas.

Interview Procedure

After initial contact and upon your approval, I will email you a set of questions (no more than 15 questions). You are expected to provide responses, via email, within 10 days of receiving the questions. The questions should not take more than 2 hours to answer in detail. Responses to these questions will be incorporated in the final report of this project.

Risks and Benefits

This study does not pose any foreseeable risks to the participants; and there are no benefits to participants in this study.

Confidentiality and Participation

Your affiliation with Openlands will be recognized in this report, as it is a case study on this specific organization. Aside from this identifier, you can decide on your preferred level of confidentiality.

Please initial next to your desired confidentiality agreement:

No confidentiality: *Your full name and position title at Openlands may be included in the final report. Initial here if you agree to these terms _____*

Partial confidentiality: *Only your first name may be included in the final report.*

Initial here if you agree to these terms _____

Full confidentiality: *No personal information will be included in the final report. You may be referred to as an anonymous staff member in the final report.*

Initial here if you agree to these terms _____

Personal information will not be requested. Original copies of the interview may be stored indefinitely but will not be accessible to anyone beside myself, unless requested with written permission from interview participants. Information from this interview will only be published in my final report.

Participants are suggested to answer all of the interview questions, but are not required to do so should they feel uncomfortable. Participation is voluntary so you may choose to discontinue at any time. If you choose to discontinue the interview, questions that have been already answered will be dismissed and will not be used in the final report.

Additional Information

You will not be compensated with payment for your participation in this study. For more information on your rights as a research subject, please contact Duke University's Office of Research Support at (919)684-3030 or ORS-Info@duke.edu. If you have questions about this specific study, please email me at charlene.wu@duke.edu.

Please sign below if you have read this consent form and agree to participate in this interview.

Participant's signature

Date

Appendix 5. Case Study

Urban Land Conservation in Chicago: A Case Study on Openlands

Introduction

Urbanization describes the increasing trend of people living in urban areas and expanding city space (Merriam-Webster, n.d.). With the spread of housing developments and new infrastructure, metropolitan areas intrude on natural landscapes and impose new threats on biodiversity. Urban areas displace sensitive species that require large contiguous habitat and present unnatural advantages to other species by providing resources for scavenging species (McKinney, 2008). Studies have revealed urban-dwelling wildlife to adapt their diets and behaviors in order to become generalist species, meaning that they can survive and thrive in a variety of environmental conditions and resources (Marzluff & Rodewald, 2008). However, cities also present new threats to biodiversity such as vehicular traffic, window collisions, human contact, and disease. Urbanization also affects human health, as urban areas are generally more polluted and devoid of vegetation and open space. Because of these consequences, urban habitat management as an environmental area of focus has become increasingly relevant.

Since urban environments comprise a blend of built spaces and natural spaces, urban habitat conservation differs from the conservation of other natural habitats that are typically thought to be pristine or untouched. A mixed approach involving the assessment of social and biological demands should be applied to urban to examine the relationship between the environment and humans. There is growing recognition that urban environments should be studied as a socio-ecological system because of anthropogenic actions affecting natural biological processes (Collins et al. 2011). Anthropogenic modifications on urban areas tend to result in a unique system of human-controlled energy and element fluxes that are not found in

natural ecosystems (Kaye et al. 2006). These effects undoubtedly affect urban biodiversity, human populations, and complex natural environmental processes.

I hypothesize that comprehensive urban conservation plans are beneficial for effective urban habitat conservation because cities should be treated as a separate environment with specialized conservation strategies and approaches. A comprehensive, all-inclusive conservation plan would be able to address all components of preserving urban environments, while considering the roles of all stakeholders in urban communities. This case study examines the tools and approaches of an urban land trust to analyze how the organization addresses the complexities of working in an urban environment and explore the potential value of a comprehensive urban conservation plan. Primary methods of this case study include a semi-structured interview and analysis that investigates the organization's tools and approaches on integrating wildlife conservation and green space development into urban habitats.

Background

This case study is one part of an umbrella project that examines urban habitat conservation and green space opportunities for the Triangle Land Conservancy (TLC). The purpose of this project is to examine existing urban conservation work and literature as a means to develop urban habitat conservation guidelines for TLC. TLC is a non-profit land trust in Durham, N.C. that works to conserve lands fulfilling the following four benefits: safeguarding clean water, supporting local farms and food, protecting natural habitat, and connecting people with nature. TLC is interested in shifting toward urban conservation work because urbanization affects all four of these benefits, either directly or indirectly. By integrating traditional land stewardship tools and new projects into an urban environment, TLC can effectively address these four benefits in future urban projects.

The role of land trusts in environmental protection is to preserve land through a variety of strategies. Typically, these lands offer natural heritage or historical value. Conservation land trusts often preserve lands that contain sensitive species, habitats, or communities. These areas may also provide natural resource value such as clean water or productive agricultural lands. Common methods of land preservation include buying the property of interest, accepting donations of the land, or purchasing a conservation easement to ensure the protection of the parcel in perpetuity (“What is a land trust?”, n.d.). Land trusts have traditionally focused on protection of wilderness areas and undisturbed habitats. However, with the rapid development of cities, urban land trusts have the potential to provide a much-needed service.

This case study focuses on Openlands, a non-profit land trust in Chicago. Openlands was chosen as the subject because of its status as one of the oldest metropolitan conservation organizations in the nation. This organization also performs work that TLC strives to conduct in urban areas. Since its establishment in 1963, Openlands has protected over 55,000 acres of land in the greater Chicago region for multiple uses including parks, wildlife refuges, greenways, urban farms, and community gardens (“Who We Are”, n.d.). This organization utilizes various conservation methods such as outreach and education, land acquisition, partnerships, and public advocacy. Openlands mostly works in the metropolitan area of Chicago but has several projects in surrounding rural areas as well. This case study examines Openlands’ operations in a large city in an attempt to form urban conservation guidelines for TLC.

Case Presentation

Survey Design

Prior to the interview process, Duke University’s Internal Review Board approved this project. The survey participant signed an informed consent form and has allowed his name and

position to be included in this report. I conducted an informal semi-structured interview via email with Andrew Szwak, Planning & Policy Analyst at Openlands. I determined the interview question content and order in advance and included a mix of open-ended questions and yes/no questions to allow for a flexible and exploratory process for Mr. Szwak to answer more honestly. The main questions that drive the need for this project are:

1. Does your organization adhere to specific state/county/city guidelines for land conservation? If so, what guidelines are they?
2. Would your organization find a comprehensive urban conservation plan to be helpful when exploring new urban projects? Why or why not?

To elaborate, a comprehensive urban conservation plan would be created by the city. Cities typically have comprehensive plans that are written and produced by the city government and reflect specific guidelines and goals, categorized by municipal sector, that the city strives to achieve by a future date (e.g. City of Harrisburg Comprehensive Plan 2010-2014). A comprehensive urban conservation plan would be a city document that solely focuses on urban conservation strategies and serves as a public resource for city managers and external organizations that want to conduct conservation work in the city. Alternatively, the comprehensive urban conservation plan can be created by an external organization, such as Openlands, if it is specifically for the organization's use. This type of document may be more useful for organizations looking to conduct urban work in general, rather than city-specific work. The answers to the main research questions above can help provide a deeper understanding of the management and conservation practices surrounding urban land trusts. Additional questions include:

1. Describe one or two of your urban projects. What is the purpose of these projects and have they been successfully?
2. What are some of the challenges that arise when working on conservation initiatives in cities?
3. Does your organization acquire vacant lots in urban areas?

The full list of questions can be viewed in Appendix 2.

Survey Results

Openlands does not adhere to specific state, county, or city guidelines for land conservation practices because Openlands is an independent organization. As an independent organization, Openlands is not restricted to public agency guidelines (A. Szwak, personal communication, January 5, 2015). However, the organization employs “preemptive criteria” that must be met in order for Openlands to engage in a project, as well as “general criteria” that are used to prioritize between projects that have met all preemptive criteria (A. Szwak, personal communication, January 5, 2015). The preemptive criteria checklist includes:

- The opportunity fits within, supports, and is consistent with Openlands’ vision, mission, and strategic plan.
- The project leads to the preservation of natural areas or open space.
- The opportunity significantly contributes to Openlands maintaining or enhancing its position as a regional leader on open space and land use issues.
- Openlands leadership and involvement are crucial to the success of the project.
- The project is within the geographic area Openlands represents.
- The project has the potential to improve quality of life in the region.
- The project fits into an overall plan or vision for the region.

General criteria comprise of benchmarks within many categories. These categories include: partnerships, staff capacity, marketing, funding, sustainability, and more. The purpose of the preemptive and general criteria, or any standard guideline, is to make sure incoming projects are compatible with the organization's mission, capabilities, and future directions. Urban conservation practices tend to cover a wide scope of projects, which is why a standardized guideline and criteria may be important for long-term efficiency.

Overall, Openlands would find a comprehensive urban conservation plan to be helpful for new urban projects. Specifically, Mr. Szwak states that an inventory of resources in an urban context would be highly beneficial (A. Szwak, personal communication, January 5, 2015). Mr. Szwak explains that these inventories are typically found in separate documents or relegated to the back of city comprehensive plans, but would be more beneficial in the physical plan. A complete inventory of plant communities, habitats, and wildlife would serve as a post-urbanization record of wildlife occurrence and distribution ("Wildlife of Arlington", 2011). In addition, an easily accessible inventory within an urban conservation plan would be able aid urban conservation groups in proficiently addressing management and protection issues. Over time, a resource inventory can help document the historical changes to an area's biodiversity relative to the impact of urban development ("Wildlife of Arlington", 2011).

As a versatile organization that works in both urban and rural projects, Openlands implements diverse conservation approaches that extend beyond typical duties of land trusts. One of Openlands' urban projects is the Lakeshore Preserve, which is 77 acres of protected land along Lake Michigan (A. Szwak, personal communication, January 5, 2015). This project preserves one of the few remaining ravine and bluff ecosystems in the metropolitan region ("What We Do", n.d.). An urban reserve such as the Lakeshore Preserve demonstrates the

untapped potential of land conservation in many urban cities. One project that incorporates environmental education and community involvement is the Eco-Explorations Program. Openlands works with local public schools to provide a curriculum-based educational experience at the Lakeshore Preserve (“What We Do”, n.d.). Additionally, Openlands has a Treekeepers program that trains volunteers in tree planting and urban forestry, and a Gardenkeepers program that helps communities establish gardens (A. Szwak, personal communication, January 5, 2015). Programs such as these promote environmental literacy in cities and connect people to nature in productive and meaningful ways.

Although urban areas provide great potential for conservation work, they certainly bring their own set of challenges. According to Mr. Szwak, one of the main challenges that arise when working on conservation initiatives in cities is the cooperation from a large number of stakeholders. When asked to elaborate on this, Mr. Szwak explained that urban conservation requires the navigation of concerns from multiple parties, such as neighborhood associations, zoning boards, police forces, and any political interests (A. Szwak, personal communication, January 5, 2015). All parties must typically agree on the intentions for a piece of property and comply with various jurisdictional policies that govern the area in question. Another issue that Openlands has encountered is the lack of traditional funding sources for urban conservation initiatives. These funding sources are less inclined to fund urban conservation projects because there are fewer benefits to biodiversity and habitat protection in urban areas compared to rural and undeveloped lands (A. Szwak, personal communication, January 5, 2015).

Another challenge that highlights the difference between land trust duties in urban areas versus rural areas is the act of land acquisition. As previously mentioned, the primary role of land trusts is to preserve land, typically through conservation easements or donation of the

property from landowners. However, acquiring and holding land in urban areas is an expensive and labor-intensive process (A. Szwak, personal communication, January 5, 2015). This process typically includes environmental site assessments, title searches, appraisals, and approvals from different parties. Because of these obstacles, Openlands does not focus on acquiring vacant lots in urban areas.

Discussion

Despite the challenges that Openlands faces in urban environments, the organization continues to carry out successful and diverse projects that may be atypical of a land trust. Openlands' projects include community greening, habitat restoration, greenway development, and environmental advocacy (A. Szwak, personal communication, January 5, 2015). Since there are many difficulties with land acquisition in the Chicago metropolitan area, Openlands forgoes land preservation as the focus of their work and is instead represented on the boards of other agencies and organizations that specialize in this task. Openlands also serves as a land acquisition consultant and provides technical assistance to local entities that are interested in acquiring land ("What We Do", n.d.). In addition, to address the lack of traditional funding sources for urban conservation initiatives, Openlands looks toward alternative funding sources dedicated to urban projects. Mr. Szwak stated that their funding typically comes from local community groups, local city governments, and other non-profit organizations focused on urban remediation (A. Szwak, personal communication, January 5, 2015).

The interview with Mr. Szwak reveals that there are significant differences between urban and rural land trust work. These differences are most present in stakeholder involvement, funding sources, project diversity, and land preservation. Because of these differences and the cooperative nature of working in a city in general, a comprehensive urban conservation plan

would be useful. Specifically, an inventory of natural resources, a compilation of existing land use regulations, and relevant contact persons would benefit urban land trusts. Mr. Szwak raised the idea of including a list of “all ongoing and complementary efforts by local governments, utilities, organizations, and other partners in conservation” (A. Szwak, personal communication, January 5, 2015). This type of list would inform the reader of current ongoing work and also act as a contact sheet.

Although wildlife conservation is typically integrated into habitat preservation, an inventory of species would be helpful when identifying ways to maintain biodiversity in cities at a broad scale and over a long-term period. Similarly, publicly accessible information on land use regulations and policies would be important as well. Mr. Szwak suggested that the inclusion of relevant land use and conservation policies in a comprehensive urban plan would be useful, so that the reader understands current regulations and enforcements that influence the project area (A. Szwak, personal communication, January 5, 2015). Many existing city plans include content on proposed policies or newly implemented policies, such as the Durham Comprehensive Plan, which includes language for “policies necessary for long-term maintenance and protection” (“Durham Comprehensive Plan, 2013). However, incorporating relevant established policies on land use and conservation would be valuable for conservation groups unfamiliar with those procedures. Although land acquisition is challenging in urban landscapes, land trusts that chose to pursue this endeavor may find a guideline comprising of this information to help streamline the project approval process and allow for transparency in urban land conservation.

For TLC, shifting toward urban conservation work will require an evaluation of current conservation strategies and prioritization of goals. In urban environments, competing interests are constantly at play along with the involvement of multiple stakeholders. For this reason, it

would be valuable for TLC to establish a role in urban conservation and decide what conservation actions (i.e. land acquisition, urban garden development, public advocacy, etc.) will help them achieve their goals and stay true to the mission of land trusts. A comprehensive urban conservation plan that includes information on other conservation strategies in addition to land acquisition may benefit TLC, who excels in preserving land through conservation easements and purchases.

Conclusion

This case study reveals that there are distinct challenges for urban land trusts, as well as significant differences in conservation tactics between urban land trust efforts and rural land trust efforts. Although a comprehensive urban conservation plan is by no means a panacea, it has the potential to provide the necessary resources for addressing many factors of protecting urban environments for both people and nature. Ideally, these types of plans would incorporate elements of wildlife conservation, green space development, and community outreach and advocacy. Additionally, a list of existing resources on land use regulations, wildlife and plant species, and contact information for relevant stakeholders would benefit the user as well. As urban habitats become more separated from natural habitats, they will require innovative and wide-ranging conservation tools and approaches. As Mr. Szwak stated, “The diversification of program areas is driven directly by the urban environment in which we focus. Land protection is not enough—protected lands in urban areas must continuously be made attractive, accessible, and well-defended” (A. Szwak, personal communication, January 5, 2015).

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